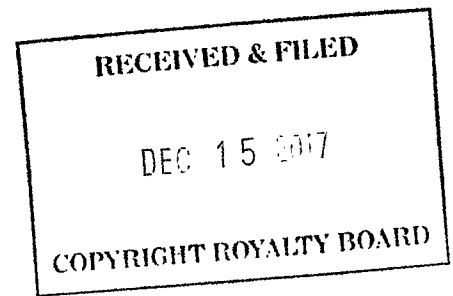


Before the
COPYRIGHT ROYALTY JUDGES
Washington, D.C.



In the Matter of)

)
Distribution of the 2004, 2005, 2006)
2007, 2008 and 2009)
Cable Royalty Funds)
_____)

Docket No. 2012-6 CRB CD 2004-2009
(Phase II)

In the Matter of)

)
Distribution of the 1999-2009)
Satellite Royalty Funds)
_____)

Docket No. 2012-7 CRB SD 1999-2009
(Phase II)

WRITTEN REBUTTAL STATEMENT REGARDING ALLOCATION
OF THE MPAA-REPRESENTED PROGRAM SUPPLIERS

VOLUME I OF II
WRITTEN TESTIMONY AND EXHIBITS

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December 15, 2017

Before the
COPYRIGHT ROYALTY JUDGES
Washington, D.C.

In the Matter of)

Distribution of the 2004, 2005, 2006)
2007, 2008 and 2009)
Cable Royalty Funds)

Docket No. 2012-6 CRB CD 2004-2009
(Phase II)

In the Matter of)

Distribution of the 1999-2009)
Satellite Royalty Funds)

Docket No. 2012-7 CRB SD 1999-2009
(Phase II)

WRITTEN REBUTTAL STATEMENT OF THE
MPAA-REPRESENTED PROGRAM SUPPLIERS

The Motion Picture Association of America, Inc. ("MPAA"), on behalf of its member companies and other producers and/or distributors of syndicated movies, series, specials, and non-team sports broadcast by television stations who have agreed to representation by MPAA ("MPAA-represented Program Suppliers"),¹ in accordance with the Copyright Royalty Judges' ("Judges") January 10, 2017 *Order Rescheduling Hearing* and September 28, 2017 *Order Rescheduling Hearing*, hereby submits its Written Rebuttal Statement in the captioned consolidated matter. MPAA is submitting this

¹ Lists of MPAA-represented Program Suppliers for each of the royalty years at issue in this consolidated proceeding are included as Appendix A to the designated cable and satellite direct testimonies of Jane Saunders. See MPAA Written Direct Statement Regarding Allocation, Vol. II, Tabs A and B.

introductory memorandum in order to summarize the rebuttal evidence it will present in this proceeding.

I. INTRODUCTION

MPAA's Written Rebuttal Statement focuses on the direct testimony offered by Independent Producers Group ("IPG") in this proceeding. MPAA offers testimony demonstrating that IPG provides neither a reliable methodology for determining the relative market value of the programming at issue in this proceeding nor a reasonable estimate of the share of cable and satellite royalties allocable to MPAA and IPG.

II. REBUTTAL TESTIMONY SUBMITTED BY MPAA

MPAA presents one rebuttal witness, Dr. Jeffrey Gray, who also submitted written direct testimony on behalf of MPAA in connection with this proceeding. Dr. Gray is the founder and President of Analytics Research Group, LLC. Dr. Gray explains the numerous flaws in IPG's proffered distribution methodology, which render it unreliable both conceptually and in its application. Specifically, Dr. Gray explains how IPG's methodology lacks economic motivation; why IPG's methodology is incomplete and unreliable; and how the data it assembled should not have been relied upon to calculate royalty shares in this proceeding. Dr. Gray further provides the Judges with an update to the royalty shares reported in his August 2016 written direct testimony to reflect the Judges' ruling in their October 27, 2016 *Order Granting IPG Fourth Motion For Modification Of March 13, 2015 Order* in which it allowed IPG to claim programming for an additional claimant for the 2008 satellite royalty year. Dr. Gray will sponsor his rebuttal testimony.

III. DESIGNATED PRIOR TESTIMONY

Pursuant to 37 C.F.R. § 351.4(b)(2), MPAA hereby designates for incorporation in their Written Rebuttal Statement Dr. Gray's prior testimony from the current Phase II proceeding (copies of which are included in Volume II of MPAA-represented Program Suppliers' Written Rebuttal Statement, as described below):

DOCKET NO. 2012-6 CRB CD 2004-2009 (PHASE II)

WITNESS

RECORD DESIGNATION

Jeffrey S. Gray Ph.D., founder and President of Analytics Research Group, LLC	Amended Written Direct Testimony (filed July 8, 2014) (admitted as MPAA Exhibit 366).
---	---

DOCKET NO. 2012-7 CRB SD 1999-2009 (PHASE II)

WITNESS

RECORD DESIGNATION

Jeffrey S. Gray Ph.D., founder and President of Analytics Research Group, LLC	Amended And Corrected Written Direct Testimony (filed July 24, 2014) (admitted as MPAA Exhibit 367).
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CONSOLIDATED DOCKET NOS. 2012-6 CRB CD 2004-2009 (PHASE II) AND 2012-7 CRB SD 1999-2009 (PHASE II)

WITNESS

RECORD DESIGNATION

Jeffrey S. Gray Ph.D., founder and President of Analytics Research Group, LLC	Written Rebuttal Testimony (filed March 27, 2015) (admitted as MPAA Exhibit 373).
Jeffrey S. Gray, Ph.D., founder and President of Analytics Research Group, LLC	Oral Testimony. Transcript pp. 33-137 (April 13, 2015), Transcript pp. 151-227 (April 17, 2015).

MPAA reserves the right to designate additional portions of the records in prior proceedings if, after examining the record designations of other parties, it appears that such additional portions are necessary for a complete and accurate understanding of the import of designated evidence.

IV. MPAA'S PHASE II CLAIMS

Based on MPAA's evidence in this proceeding, MPAA seeks an order from the Judges awarding the following percentages of the Program Suppliers' shares of the 2004-2009 Cable Royalties and 2000-2009 Satellite Royalties:

<u>Cable Royalty Year</u>	<u>MPAA Share Of PS Fund (%)</u>	<u>IPG Share Of PS Fund (%)</u>
2004	99.60%	0.40%
2005	99.60%	0.40%
2006	99.34%	0.66%
2007	99.44%	0.56%
2008	99.28%	0.72%
2009	99.44%	0.56%

<u>Satellite Royalty Year</u>	<u>MPAA Share Of PS Fund (%)</u>	<u>IPG Share Of PS Fund (%)</u>
2000	99.54%	0.46%
2001	99.75%	0.25%
2002	99.74%	0.26%
2003	99.65%	0.35%
2004	99.87%	0.13%
2005	99.73%	0.27%
2006	99.65%	0.35%
2007	99.77%	0.23%
2008	99.78%	0.22%
2009	99.57%	0.43%

MPAA reserves the right to amend its Written Rebuttal Statement and to change their Phase II claims as appropriate in light of the evidence presented by IPG.

Respectfully submitted,

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December 15, 2017

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Before the
LIBRARY OF CONGRESS
Copyright Royalty Judges

<i>In re</i> DISTRIBUTION OF 2004, 2005, 2006, 2007, 2008 and 2009 Cable Royalty Funds	DOCKET NO. 2012-6 CRB CD 2004-2009 (Phase II)
<i>In re</i> DISTRIBUTION OF 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008 and 2009 Satellite Royalty Fund	DOCKET NO. 2012-7 CRB SD 1999-2009 (Phase II)

REBUTTAL TESTIMONY OF JEFFREY S. GRAY, PH.D.

December 15, 2017

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I. INTRODUCTION & PROCEDURAL BACKGROUND

1. I, Jeffrey Gray, am an economist and President of Analytics Research Group, LLC (“ARG”). ARG provides expert analysis concerning economic, statistical and data issues.
2. The above captioned cable and satellite proceeding was consolidated on August 29, 2014.¹ I first submitted written direct and rebuttal testimonies in this proceeding in 2014 and 2015, which calculated shares of the 2004-2009 Cable Royalties and 2000-2009 Satellite Royalties within the Program Suppliers category allocable to both Motion Picture Association of America, Inc. (“MPAA”) and Independent Producers Group (“IPG”) based on distant viewing estimates of MPAA’s and IPG’s claimed programs.²
3. Also, IPG first submitted written and rebuttal testimonies in this proceeding in 2014 and 2015, and in 2015 submitted the supplemental testimony of Laura Robinson, Ph.D.³ purporting to analyze “the relative market value of the retransmitted broadcasts claimed by IPG and the non-IPG claimants, and estimated the share of royalties attributable to IPG.”⁴
4. On May 4, 2016, the Copyright Royalty Judges (“Judges”) issued an order to reopen the record for further proceedings (“Further Proceeding”), and directed the parties to submit new

¹ See *Order Of Consolidation And Amended Case Schedule*, Docket Nos. 2012-6 CRB CD 2004-2009 (Phase II) and 2012-7 CRB SD 1999-2009 (Phase II) at 1 (August 29, 2014).

² See Amended Written Direct Testimony of Jeffrey S. Gray, Ph.D., Docket No. 2012-6 CRB CD 2004-2009 (Phase II) (July 8, 2014); Corrected Amended Written Direct Testimony of Jeffrey S. Gray, Ph.D., Docket No. 2012-7 CRB SD 1999-2009 (Phase II) (July 24, 2014) (collectively, “Gray July 2014 Testimony”) and Rebuttal Testimony of Jeffrey S. Gray, Ph.D., Docket Nos. 2012-6 CRB CD 2004-2009 (Phase II) and 2012-7 CRB SD 1999-2009 (Phase II) (March 27, 2015) (“Gray March 2015 Testimony”) (collectively, “Gray Initial Proceeding Testimonies”). Copies of my 2014 and 2015 Testimonies can be found in Volume II of MPAA’s Written Rebuttal Statement at Tabs A-C (Prior Designated Testimony).

³ Supplemental Report of Laura Robinson, Ph.D., executed July 3, 2014 (“Robinson Initial Proceeding Supplemental Report”), Rebuttal Report of Laura Robinson, Ph.D., executed March 27, 2015 (“Robinson Initial Proceeding Rebuttal Report”) (collectively, “Robinson Initial Proceeding Testimonies”).

⁴ See Robinson Initial Proceeding Supplemental Report, par. 3.

written direct testimony addressing royalty allocation.⁵ In response to the *May 4 Order*, MPAA obtained additional Nielsen data. For this Further Proceeding, I have recalculated MPAA's and IPG's distant viewing shares, relying on these additional data and the data described in the Gray Initial Proceeding Testimonies. I reported these updated viewing calculations in my August 22, 2016 written direct testimony.⁶ The resulting updated estimates were consistent with the results reported in the Gray Initial Proceeding Testimonies.⁷

5. For this Further Proceeding, IPG submitted the following testimony: August 22, 2016 testimony of Charles D. Cowan, Ph.D. ("Cowan Original Report"); August 30, 2016 amended testimony of Charles D. Cowan, Ph.D. ("Cowan Amended Report"); and, October 20, 2016 amended testimony of Charles D. Cowan, Ph.D. ("Cowan Corrected Amended Report").⁸

6. In this testimony, I focus on the Cowan Corrected Amended Report.⁹ Overall, Dr. Cowan's proposed relative market value analysis provides neither a reliable distribution methodology nor a reasonable estimate of the share of cable or satellite royalties allocable to MPAA and IPG.

⁵ See *Order Reopening Record And Scheduling Further Proceedings* in this matter ("May 4 Order").

⁶ Testimony of Jeffrey S. Gray, Ph.D., Docket Nos. 2012-6 CRB CD 2004-2009 (Phase II) and 2012-7 CRB SD 1999-2009 (Phase II) (August 22, 2016) ("Gray August 2016 Testimony").

⁷ See Gray March 2015 Testimony at par. 21-22; Gray August 2016 Testimony at par. 49, Table 4.

⁸ The Cowan Corrected Amended Report was filed as an attachment to IPG's October 20, 2016 Motion For Leave To File Amended Written Direct Statement. The Judges ultimately granted IPG's motion and permitted the filing of the Cowan Corrected Amended Report. See *Order On IPG Motion For Leave To File Amended Written Direct Statement* at 5 (January 10, 2017) ("January 10 Order.") The Judges concluded that Dr. Cowan had changed his methodology between the Cowan Original Report and the Cowan Amended Report, See *January 10 Order* at 4.

⁹ While this testimony focuses on the Cowan Corrected Amended Report, Appendix A presents results from my replication of his original and changed methodologies. These results demonstrate that Dr. Cowan's methodological change caused a twenty-six percentage *point* change, on average, in his cable and satellite royalty share calculations. This dramatic difference undermines Dr. Cowan's testimony that his two approaches were "exactly the same." See Declaration of Dr. Charles Cowan, Docket Nos. 2012-6 CRB CD 2004-2009 (Phase II) and 2012-7 CRB SD 1999-2009 (Phase II) (September 9, 2016) ("Cowan September 2016 Declaration"), par 5.

7. Section II of this testimony describes how Dr. Cowan's methodology lacks economic motivation, fails to calculate Shapley values as claimed, and is unsupported by a coherent economic theory. Section III critiques Dr. Cowan's regression methodology, as well as his alternative estimates of royalty shares. Dr. Cowan's regression approach lacked adequate description, ignored program offerings, and was incomplete and unreliable; his alternative estimates were based on a previously rejected volume-based approach, and also were unreliable. Section IV describes how the data assembled by Dr. Cowan should not have been relied upon to calculate royalty shares because the data were biased, ignored prior updates and corrections; failed to make changes to share calculations ordered by the Judges;¹⁰ and were assembled in a manner that resulted in unreliable royalty shares. Section V contains my concluding remarks and my proposed cable and satellite royalty shares for MPAA and IPG in the Program Suppliers category.

II. DR. COWAN'S REGRESSION-BASED MODEL LACKED ECONOMIC MOTIVATION.

8. Counsel for MPAA asked that I respond to Dr. Cowan's suggestion that his regression-based share allocations represented a Shapley value, and respond to the economic theory he put forth as motivation for his regression analysis.

¹⁰ See *Ruling and Order Regarding Claims and Separate Opinion*, Docket No. 2008-1 CRB CD 98-99 at 20-21 (June 18, 2014) and *Memorandum Opinion and Ruling on Validity and Categorization of Claims*, Docket Nos. 2012-6 CRB CD 2004-2009 (Phase II) and 2012-7 CRB SD 1999-2009 (Phase II) (March 13, 2015) ("*March 13 Opinion and Ruling*").

A. *Dr. Cowan Did Not Calculate a Shapley Value.*

9. Dr. Cowan noted that the Judges advocated the use of Shapley values in a prior ruling.¹¹

The Shapley value provides one possible mathematical solution to a class of problems arising in cooperative game theory.¹² In this class of problems, or “games,” a coalition of participants cooperates, generating an overall surplus to their cooperation. The Shapley value is one theoretical solution to how the overall surplus could be distributed to the game’s participants. While the Shapley value has desirable mathematical properties, it is not feasible to calculate in the current context. For example, one would have to know how each permutation of program ordering by each broadcast station would impact the overall net revenues of each CSO.¹³

10. Rather than reordering programs carried on distantly retransmitted signals, the CSO chooses which broadcast stations to retransmit and bundle with other CSO channels such as cable network channels, premium cable networks, and pay-per-view channels in different packages to existing and potential subscribers at varying prices. Each broadcast station carries a fixed set of programming that cannot be manipulated by the CSO retransmitting the station. Therefore, given the elements of this case, it is not possible to calculate a Shapley value.

11. Dr. Cowan suggested in paragraphs 7 and 8 of the Cowan Corrected Amended Report that he presented a Shapley value calculation, but he did not. Instead he presented a regression analysis that supposedly measures how the number of IPG, MPAA, and the Settling Devotional Claimants’ (“SDC”) programs carried on retransmitted stations impacted the number of

¹¹ Cowan Corrected Amended Report, at par. 7. In an earlier decision, the Judges suggested the Shapley valuation approach as a possible approach to allocating royalties among the claimants. *See e.g., Ruling and Order Regarding Claims and Separate Opinion*, Docket No. 2008-1 CRB CD 98-99 at 20-21 (June 18, 2014).

¹² Shapley, Lloyd S. (1953). “A Value for n -person Games.” In Kuhn, H. W.; Tucker, A. W. *Contributions to the Theory of Games*. Annals of Mathematical Studies. 28. Princeton University Press. pp. 307–317.

¹³ A broadcast station has $n!$ different ways of selecting or arranging its n programs each day. Thus, if a station had as few as eight programs to broadcast it could order them $8!$, or 40,320 different ways.

subscribers to a CSO or satellite carrier. Such a calculation is not a Shapley value, and as described later in this testimony, Dr. Cowan's measures did not provide a reliable measure of the relative market value of retransmitted programming.¹⁴

B. The Economic Theory Underlying the Cowan Regression Methodology is Confused.

12. Dr. Cowan theorized that "a CSO can decide to pay or not pay for a station" and that if the fee to retransmit a station "is too high, the CSO can simply decide not to offer the station based on what potential subscribers are being brought to the CSO."¹⁵ Dr. Cowan went on to argue that the transaction between the CSO and station owner was "a fair market transaction in the market where the CSO obtains packages of programs with the ability to accept or reject based on the pricing and the expected value to the CSO."¹⁶

13. To summarize Dr. Cowan's theory, if the cost to retransmit a station exceeds the benefit in terms of additional subscribers, the CSO would not retransmit the station. However, that theory ignored the existing regulatory framework. That is, the fees paid to retransmit a station are statutorily-set based on the number and type of stations retransmitted by the CSO as well as the CSO's gross receipts, or, in the case of satellite systems, the number of subscribers per month. Under the current regulation, even if a CSO received no benefit from retransmitting any signal on a distant basis in terms of the retention or attraction of subscribers, the CSO still would face a mandatory minimum fee. In formulating his theory, Dr. Cowan either was unaware of, or ignored, the regulated nature of the market. Further, I disagree that the transaction between the

¹⁴ In a later declaration, Dr. Cowan admitted that he was not "doing exactly the Shapley analysis," although he went on to suggest that he had conducted a "Shapley-like analysis." See Declaration of Dr. Charles Cowan, Docket Nos. 2012-6 CRB CD 2004-2009 (Phase II) and 2012-7 CRB SD 1999-2009 (Phase II) (November 3, 2016) at par 5. His calculation is not a Shapley value, nor, in my opinion, is it akin to a Shapley value.

¹⁵ Cowan Corrected Amended Report at par. 13.

¹⁶ *Ibid.*

CSO or satellite system and the broadcast station represented a “fair market transaction.” Rather, the existence of a compulsory license, by definition, precluded a fair market transaction.

14. Dr. Cowan further argued that CSOs’ valuation of program titles could not vary significantly among CSOs, that CSO revenues depend on subscriber count, and that subscribers pay a single fee for a bundle of offered programs.¹⁷ He then concluded that, consequently, CSOs are indifferent to program viewership. I do not follow or agree with Dr. Cowan’s reasoning and I believe his conclusion is a *non-sequitur*.

15. While a major source of CSO and satellite system revenue is from customer subscription fees, I am not aware of any economic theory underlying Dr. Cowan’s assertion that subscriber tastes and preferences cannot significantly vary. Because CSOs and satellite systems often compete amongst each other for these heterogeneous subscribers, a net-revenue maximizing strategy for certain cable or satellite systems could be to differentiate themselves in terms of channels and program offerings.

16. Moreover, CSOs and satellite systems could (and do) offer alternative packages of channels, with different varieties of programming, to attract and retain these heterogeneous subscribers. While a subscriber may pay a single fee for the channels and programs received, the subscriber’s monthly fee paid may be higher or lower depending upon which package of channels the subscriber chooses. Whether a subscriber values a particular program aired on a channel bundled with multiple other channels can be measured by the subscriber’s viewing of the program on that channel. A channel with a cost of carrying that is never viewed by any subscriber will be dropped by the net-revenue maximizing CSO or satellite system operator.

¹⁷ *Ibid*, at pars. 14-15.

Thus, contrary to Dr. Cowan's assertion, CSOs' valuation of program titles could vary among CSOs.

17. Because CSOs and satellite systems seek to attract and retain subscribers, particularly subscribers of higher-revenue generating bundles of programming, subscriber viewership is important to CSOs and satellite systems. This importance is consistent with economic theory as well as the testimony by CSO and satellite system executives responsible for selecting programming, including which (if any) distant signals to carry.¹⁸

C. Dr. Cowan's Examples of "Exactly the Same" Comparable Economic Problems Provided No Support for His Theory that Viewing is Irrelevant.

18. Dr. Cowan offered three examples of economic problems he faced in the past that he claimed supported his theory that "viewing of the IPG, SDC, or MPAA programs has no relevancy."¹⁹ I disagree with Dr. Cowan's claims that his examples support his conclusion, and disagree with his conclusions as well.

19. Dr. Cowan first described two examples from his prior work as "exactly the same" as the problem faced in this litigation.²⁰ In both examples his goal was to estimate the value of individual characteristics or features bundled together as a part of single good. In his first example, his task was to estimate the value of individual loans or assets that the FDIC bundled together and sold in bulk sales or at auctions. In his second example, his task was to estimate the value of individual features of Fiat cars that were bundled together as components of each automobile and sold to customers in several European countries.

¹⁸ See, e.g., Supplemental Testimony of Toby Berlin, Docket Nos. 2012-6 CRB CD 2004-2009 (Phase II) and 2012-7 CRB SD 1999-2009 (Phase II) (filed August 22, 2016).

¹⁹ Cowan Corrected Amended Report at par. 7.

²⁰ *Ibid*, at par. 22 and par. 25.

20. Unlike the task at hand here, however, in both of Dr. Cowan's examples, market prices of the bundled goods were available.²¹ In his bank assets example, the market price of each pool of assets was set in the market, in bulk sales or at auctions. Also, in his Fiat Automotive example, market prices of cars sold in Europe were available.

21. Thus, if Dr. Cowan was provided sufficient and accurate information concerning the factors influencing the market price of the bundled goods – the characteristics of the loans/assets that were bundled together and the features of each car that were bundled together – then, it would have been possible for him to use regression analyses to value the implicit market prices of each of the underlying unbundled characteristics or features.

22. Dr. Cowan did not provide the data or the models he used in his bank assets or Fiat car examples in discovery. Therefore, I am unable to comment on the appropriateness of the models or the reasonableness of the prices he estimated for the unbundled goods in those matters.

23. However, in the current matter, there is no readily available information concerning market prices. Instead, the only transaction price information available concerning the bundled goods at issue in this proceeding, retransmitted broadcast signals, are the regulated fees paid by cable and satellite systems. These regulated fees paid are statutorily set and are not market prices. In addition, there are regulatory minimum mandatory fees causing cable systems to face nonlinear constraints in selecting a station or stations to carry. Neither of Dr. Cowan's first two examples is applicable to the issues faced in this matter.

24. In his third example, apparently Dr. Cowan showed up at an airport and rented a car. The rental car market in the U.S. is competitive. Whether a customer reserves a car in advance or selects a car on-site, the customer typically can select among several vehicle types that embody a variety of different features. The rental car category types can differ across rental car companies,

²¹ *Ibid*, at par. 18 and par. 23.

but have descriptive names along the lines of “compact,” “economy,” “standard,” “full-size,” “premium,” “luxury,” “specialty,” “minivan,” “SUV,” and “van.” Cars in these different categories tend to have different features, including those Dr. Cowan cited in this Fiat example: differing horsepower, wheelbase, interior room, trunk space, among others.²² These vehicle features are known, at least to a significant extent, when reserving or selecting a car category to rent. The rental price varies across these car categories that contain different expected features.²³

25. Thus, as with Dr. Cowan’s Fiat example, with sufficient data, it would be possible to use regression analysis to estimate the value of each rental car feature. These features have value to the customer because of their usage or expected usage. Therefore, I disagree with Dr. Cowan’s conclusion that usage of these rental car features is “immaterial” to either the customer or the company.²⁴ On the contrary, customers pay more for rental cars with different features, such as a convertible roof or 15-passenger seating, they intend to use.²⁵

26. A customer’s willingness to pay for a rental car depends upon the car’s features she intends to use. Similarly, cable and satellite systems’ willingness to pay for a broadcast signal to retransmit depends upon the expected interest of their subscribers in the programming carried by that station. Cable and satellite systems’ interest is in the ability of programs to assist in the attraction and retention of subscribers. Subscribers’ interest is measured by the viewing of the bundled programming. That is, subscribers pay cable and satellite systems to have access to

²² *Ibid*, at par. 23.

²³ See, e.g., <https://www.avis.com/en/reservation#/vehicles> for a list of available vehicles by type and associated prices, which may vary upon the date and location the vehicle is rented (website last visited 11/29/2017).

²⁴ Cowan Corrected Amended Report at par. 26.

²⁵ E.g., the price for a December 15, 2017 weekend rental at Reagan National Airport of a 15-passenger van was \$584, the rental price for a convertible was \$320, and the rental price of a compact car was \$38 (see <https://www.avis.com/en/reservation#/vehicles>, website visited on 11/29/2017, for a vehicle reserved and paid in advance for pick-up at noon on 12/15/2017 and returned by noon on 12/17/2017).

programming they intend to view. Cable and satellite systems assemble channels with programming to attract subscribers wanting to view that programming. Thus, viewing has relevancy.

III. REVIEW OF THE COWAN REGRESSION METHODOLOGY AND ALTERNATIVE ESTIMATES

27. Dr. Cowan presented the following two allocation methodologies for distributing royalty funds between MPAA and IPG:

- (i) a regression-based methodology which purportedly estimated the relationship between the natural logarithm of the number of subscribers of cable and satellite systems and the number of IPG and MPAA programs carried on retransmitted stations; and,
- (ii) a previously rejected IPG volume-based share methodology that compared the relative number of subscriber-weighted IPG and MPAA program hours carried on retransmitted signals.²⁶

28. Relying upon the data and spreadsheets provided by IPG in discovery, I was able to reproduce Dr. Cowan's regression-based and the old-IPG volume-based results. In Section IV of this testimony, I discuss flaws in the data Dr. Cowan relied upon for his calculations. In this Section III, I discuss flaws in Dr. Cowan's two methodological approaches.

29. Dr. Cowan performed two regression models: one related to the number of cable subscribers and one related to the number of satellite subscribers. Each regression model estimated the relationship between the natural logarithm of the number of subscribers, to a cable or satellite system, and (1) the number of devotional IPG programs, (2) the number of SDC

²⁶ Dr. Cowan did not refer to these volume-based measures as resulting from his methodology. Rather, he referred to them as "alternative estimates" based on his consideration of "the computations that IPG has performed in the past." *See ibid*, at 11.

programs, (3) the number of IPG Program Suppliers programs, and (4) the number of MPAA programs carried on distantly retransmitted signals, adjusting for the average number of subscribers by call sign and year.²⁷

30. Neither Dr. Cowan's cable regression model nor his satellite regression model included explanatory variables measuring other types of programming carried on distantly retransmitted signals such as live team sports, Canadian, and station-produced (i.e., local) programming. Also, those regression models did not adjust for other factors expected to influence a customer's decision to subscribe to a cable or satellite system such as other channels bundled by the system operators with the distant signals carried, the price of each offered bundle of channels, or the price of competitors' offerings.²⁸

31. Instead, Dr. Cowan estimated incomplete cable and satellite models and focused on his calculated relationships between the number of SDC, MPAA, and IPG Program Suppliers and Devotional programs, (1) through (4) in paragraph 29 above, and the natural logarithm of the number of cable or satellite subscribers.²⁹ He stated that these estimated relationships are marginal returns allowing him to "create a summary of what was gained by IPG relative to what was gained by SDC, relying on the shows they offered and the number of additional subscribers that resulted from their shows."³⁰

²⁷ Appendix B presents details of Dr. Cowan's cable and satellite regression models, as well as the results from my replication of those regressions.

²⁸ The bias in measuring the effect of one factor, *e.g.*, the number of programs by type, on another factor, *e.g.*, the number of subscribers, created by excluding important factors from a regression model is referred to as "omitted-variable bias" in the econometrics literature. *See, e.g.*, Greene, W. H. (1993). *Econometric Analysis* (2nd ed.), §8.4.2, pp. 245–247.

²⁹ These estimated relationships from his regression models generated coefficients that he labeled as "g" for IPG Program Suppliers programs and "h" for MPAA programs.

³⁰ *Ibid* at par. 34. Dr. Cowan described his summary estimation of IPG relative to SDC then went on to state that "[e]xactly the same methods are used for Program Supplier comparisons," *ibid* at par. 36. However, Dr. Cowan's flawed cable and satellite regressions included Program Suppliers and Devotional category controls in the *same*

32. Dr. Cowan reported this summary as the exponentiated product of the respective coefficients from his regressions and the number of IPG or MPAA programs carried on distantly retransmitted stations, as expressed below:

$$\text{(Cowan - Equation 2)} \quad A = \exp(g * \sum_{CS=1}^{\# \text{ call signs}} \#IPG \text{ ProgSupp Shows}_{CS})$$

$$\text{(Cowan - Equation 3)} \quad B = \exp(h * \sum_{CS=1}^{\# \text{ call signs}} \#MPAA \text{ Shows}_{CS})$$

33. While Dr. Cowan stated that these equations measure cable and satellite system marginal returns, his report did not describe how he used these so-called marginal return measures to calculate his recommended royalty shares for IPG and MPAA. The following section discusses the missing information and highlights the related methodological problems.

A. *Dr. Cowan Did Not Describe How He Calculated His Regression-Based Royalty Shares.*

34. Despite Dr. Cowan's declaration that his regression-based methodology "was well explained in (his) first submission, dated August 22,"³¹ that explanation was not clear. The equations reproduced in paragraph 29 above were the only equations Dr. Cowan provided in the Cowan Corrected Amended Report as supporting his calculation of IPG's and MPAA's shares. However, I could not determine, based only on the Cowan Corrected Amended Report, how Dr. Cowan calculated his royalty shares. It was only after reviewing additional spreadsheets IPG provided in discovery and reverse-engineering his calculations, that I was able to replicate his IPG and MPAA royalty shares.

regressions. Therefore, what Dr. Cowan calculated - the relative value of Program Suppliers and Devotional programming was inappropriate and irrelevant. Notwithstanding, Dr. Cowan ignored this issue, relied upon his calculated results, and made independent comparisons within the Program Suppliers and Devotional categories.

³¹ Cowan September 2016 Declaration, par 4, p. 2.

35. With the aid of the additional documents provided by IPG, I determined that Dr. Cowan calculated IPG's royalty share for each year as $IPG_{value} / (IPG_{value} + MPAA_{value})$, where IPG_{value} and $MPAA_{value}$ are calculated by the formulae below:

$$IPG_{value} = \exp\left(\frac{g * \sum_{cs=1}^{\# \text{ call signs}} \# \text{ IPG ProgSupp Shows}_{cs}}{\# \text{ Call Signs}}\right) * \frac{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ Subscribers}_{cs}}{\# \text{ Call Signs}}$$

$$- \frac{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ Subscribers}_{cs}}{\# \text{ Call Signs}} + \frac{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ IPG ProgSupp Shows}_{cs}}{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ ProgSupp Shows}_{cs}}$$

$$* \frac{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ Subscribers}_{cs}}{\# \text{ Call Signs}}$$

Cowan Equation 2 highlighted (Marginal Value of IPG Programs)

Cowan Equation 3 highlighted (Marginal Value of MPAA Programs)

$$MPAA_{value} = \exp\left(\frac{h * \sum_{cs=1}^{\# \text{ call signs}} \# \text{ MPAA Shows}_{cs}}{\# \text{ Call Signs}}\right) * \frac{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ Subscribers}_{cs}}{\# \text{ Call Signs}}$$

$$- \frac{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ Subscribers}_{cs}}{\# \text{ Call Signs}} + \frac{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ MPAA Shows}_{cs}}{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ ProgSupp Shows}_{cs}}$$

$$* \frac{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ Subscribers}_{cs}}{\# \text{ Call Signs}}$$

36. Dr. Cowan did not explain these calculations or present them in his testimony. He described only the highlighted terms in formulae above (those highlighted terms are the marginal returns formulae shown in Equations 2 and 3 paragraph 32 above). What Dr. Cowan did not make clear was that each of the marginal returns equations is only *one of several components* used to determine his calculated IPG_{value} and $MPAA_{value}$, and therefore his calculated MPAA and IPG shares. In other words, contrary to what the Cowan Corrected Amended Report

appeared to suggest, the regressions alone did not yield Dr. Cowan's recommended allocations for MPAA and IPG.

37. Dr. Cowan did not mention the additional mathematical terms employed in the formulae, let alone explain why they were necessary for determining MPAA and IPG shares or why his regressions alone were insufficient for calculating MPAA and IPG shares. This was an important omission because due to these additional terms, even if Dr. Cowan's regressions indicated that the marginal returns for a party's programming were zero, that party would still be awarded a royalty share. Dr. Cowan provided neither economic rationale to support this assumption nor any economic rationale to support his calculated valuation methodology.

38. Dr. Cowan's regression-based methodology did not provide reliable allocation estimates of the number of additional subscribers attributable to a program carried on a distantly retransmitted signal. Therefore, the methodology, in addition to being potentially biased, is unreliable.

B. Dr. Cowan's Regression Model Ignored the Variety of Program Offerings.

39. Whether subscribers, and therefore cable and satellite systems, prefer variety in program offerings can be evaluated by examining program viewing levels. However, Dr. Cowan's regression model did not attempt to measure or adjust for the variety of MPAA or IPG programming. His measure of the number of programs aired is just that, the total number of programs aired. Dr. Cowan's regression methodology, for example, forced a single movie aired and retransmitted 100 times and 100 unique movies each aired and retransmitted once to have the same impact on his measure of the so-called marginal value of IPG and MPAA programming. Dr. Cowan did not offer any economic rationale for this assumption.

C. Dr. Cowan's Volume-Based Alternative Royalty Shares are Retrograded Estimates Based on a Rejected Methodology.

40. Dr. Cowan presented alternative royalty share estimates based on programming volume. This volume-based methodology is similar to that previously presented in the Robinson Initial Proceeding Supplemental Report. As I described in the Gray March 2015 Testimony, Dr. Robinson calculated the value of IPG- and MPAA-represented programming as an index equal to the product of hours broadcasted ("*Broadcast Hours*"), the number of subscribers of the cable or satellite systems carrying the distantly retransmitted broadcast ("*Subscriber Count*"), and a broadcast time-of-day adjustment ("*Time Period Weight Factor*").

41. In the Gray March 2015 testimony, I argued that IPG's proposed measure of a program's value only measured the program's opportunity for viewing and therefore was, at best, an indirect and incomplete measure of a program's actual viewing. In reopening the record for this Further Proceeding, the Judges rejected Dr. Robinson's approach and agreed that "to the extent IPG's purported indicia of value have any relevance in this proceeding; it is because of their relationship to viewership."³²

42. Dr. Cowan modified Dr. Robinson's approach by simply excluding the *Time Period Weight Factor* portion of the IPG index, making Dr. Cowan's volume-based, alternative share simply a calculation of the product of *Broadcast Hours* and *Subscriber Count*.

43. In theory, IPG's *Time Period Weight Factor* attempted to adjust for the number of households expected to be viewing television during the time period a particular program aired. Thus, the *Time Period Weight Factor* to the IPG index at least provided a better measure of the number of households with the opportunity to view a particular program than its index without it.

³² May 4 Order, at p. 7.

Dr. Cowan's exclusion of the *Time Period Weight Factor*, therefore, leads to an even more inferior and less reliable measure of value than did the original IPG index.

44. Consequently, both Dr. Cowan's regression methodology and his previously rejected volume-based methodology are unreliable. Applying an unsound methodology to any data cannot be expected to yield reliable results. Relying on flawed data worsens the situation. As demonstrated in the next section, the data Dr. Cowan constructed to calculate royalty share calculations were themselves severely inaccurate, and thus, unreliable. As a result, even a sound methodology, not yet proffered by IPG, applied to Dr. Cowan's assembled data, would generate unreliable share allocations.

IV. UNRELIABLE DATA RENDER COWAN'S SHARE CALCULATIONS UNRELIABLE

45. Dr. Cowan's analysis relies upon the same data sources Dr. Robinson relied upon in the Robinson Initial Proceeding Testimonies. Dr. Cowan did not introduce any new data in support of his calculations. In this section, I again delineate the uncorrected flaws in the data Dr. Robinson relied upon, as well as significant new flaws introduced by Dr. Cowan. A sound methodology applied to these flawed data would yield unreliable results. This follows from the GIGO concept common to computer science and data analytics: Garbage In, Garbage Out.

A. *Dr. Cowan Relied on Incomplete and Inaccurate Data.*

46. In the Robinson Initial Proceeding Testimonies, Dr. Robinson constructed and relied upon (i) a list of IPG claimed program titles carried on a sample of stations retransmitted by cable and satellite systems by royalty year ("IPG Data"), and, (ii) a list of MPAA claimed titles carried on a different random sample of stations retransmitted by cable and satellite systems by royalty year ("MPAA Data"). Both MPAA and IPG exchanged data concerning claimed titles in discovery in 2014. Following its provision of data to IPG, MPAA made revisions and

corrections to its list of titles, which MPAA provided to IPG in discovery in both the Initial Proceeding and this Further Proceeding. However, Dr. Cowan's calculations did not use MPAA's updated data set in his calculations.

47. In addition, in relying on Dr. Robinson's data, Dr. Cowan did not correct for any flaws I identified in her data. In the Gray March 2015 Testimony, I provided a list of flaws in the construction of the Dr. Robinson's data and described how Dr. Robinson:

- a. incorrectly attributed titles to IPG for years that IPG did not assert claims;
- b. incorrectly attributed title to IPG for which IPG did not assert any claim;
- c. incorrectly calculated program length for certain programs;
- d. incorrectly counted non-compensable titles as compensable; and,
- e. relied upon incomplete data with missing program information.³³

48. Dr. Cowan did not correct any of these data flaws. As a result, Dr. Cowan assumed IPG representation of titles where the Judges had disallowed IPG representation or where the Judges awarded representation of the title and/or claimant to MPAA. For example, according to Dr. Cowan's data, thirty-two different programs owned by Feed The Children, Inc. ("Feed The Children"), were attributed to IPG. However, the Judges disallowed IPG's claimed representation of Feed The Children in the *March 13 Opinion and Ruling*.³⁴

49. Furthermore, although all conflicting title claims were resolved in MPAA's favor as part of the *March 13 Opinion and Ruling*, many program titles in Dr. Cowan's data continued to be classified as being represented by *both* IPG and MPAA.³⁵

³³ See Gray March 2015 Testimony at par. 27-34.

³⁴ See *March 13 Opinion and Ruling* at 41, n.50 (recognizing that IPG's counsel acknowledged on the record that IPG was withdrawing any claim on behalf of Feed The Children), and Ex. A-1 at 11 (recognizing that IPG's claim on behalf of Feed The Children was dismissed due to the claimant's termination of IPG representation).

³⁵ *Ibid.* at 25.

50. Dr. Cowan's data of the number of MPAA-represented and IPG-represented programs, for each cable and satellite year, therefore, are wrong. Since Dr. Cowan's calculated royalty shares were dependent on the simple number of programs retransmitted, his reliance on inaccurate data leads to unreliable royalty share calculations.

B. Dr. Cowan Relied on a Flawed Combination of Two Samples Generating Unreliable Cable Data.

51. Even if Dr. Cowan were to correct all the above-mentioned flaws in his methodologies and the data he relied upon, he would still be unable to deliver reliable results. In the Gray Initial Proceeding Testimonies, I criticized Dr. Robinson's analysis for relying on a biased, non-representative, overlap of the IPG Data and the MPAA Data (the "Robinson Overlap").

52. For his analysis, Dr. Cowan also combined the uncorrected IPG Data and MPAA Data, but used the combinations in a manner that differed from Dr. Robinson. Notwithstanding, his approach also is indefensible, and his resulting data could not provide reliable results for either his cable or satellite analysis.³⁶

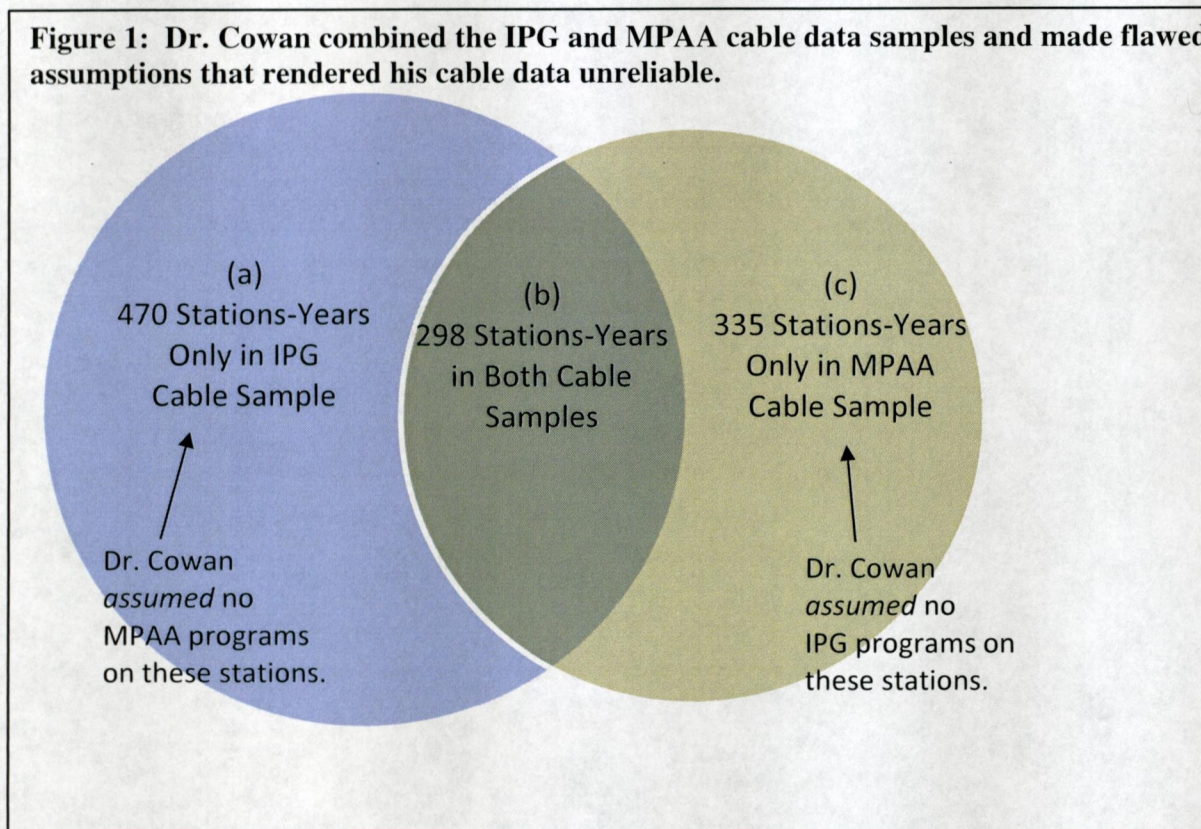
53. Dr. Cowan combined the IPG Data and MPAA Data, consisting of different samples of stations retransmitted by cable systems across the 2004-2009 royalty years, to create three types of combinations of stations and years ("stations-years") in the data:³⁷ (a) stations-years only in the IPG samples; (b) stations-years in both the IPG and the MPAA samples (the Robinson Overlap); and (c) stations-years only in the MPAA samples. Figure 1 below presents a graphical representation of Dr. Cowan's combinations of the IPG Data and MPAA Data to create the three

³⁶ In addition to the methodological flaws in constructing his data described later in this testimony, when Dr. Cowan attempted to match stations in his samples with stations in the Cable Data Corporation data, he inappropriately excluded some stations from his analysis.

³⁷ Stations-years are defined as the number of instances a station appears across all royalty years. For example, KCTV was randomly selected as part of the 2004 and 2005 MPAA stratified samples. These are counted as two stations-years in the MPAA data.

types of stations-years cable samples. The blue circle on the left represents the IPG Data and the green circle on the right represents the MPAA Data.

Figure 1: Dr. Cowan combined the IPG and MPAA cable data samples and made flawed assumptions that rendered his cable data unreliable.



54. Collectively, across the IPG and MPAA cable samples for 2004 through 2009, there were a total of 1,103 stations-years. Of those 1,103 stations-years, 470 appeared only in the IPG samples, 335 appeared only in the MPAA samples; and 298 appeared in both the MPAA and IPG samples.

55. In his analysis, Dr. Cowan credited both MPAA and IPG with their claimed programs *only* when those programs appeared in the overlapping sample that consisted of 298 stations-years. For the 470 stations-years which appeared only in the IPG stations samples, Dr. Cowan

credited only IPG with programming and assumed that MPAA had *no* programming on those stations. However, MPAA had programming on each of the remaining 633 stations-years (*i.e.*, the total of the other two data sets, 298 plus 335). Thus, in all likelihood, thousands upon thousands of MPAA-represented programs were carried on those 470 stations-years in the IPG-only-stations samples. Dr. Cowan could have identified, but did not attempt to identify, any MPAA titles on the 470 stations-years using information regarding MPAA claimed titles on the other 633 stations-years.

56. Dr. Cowan treated IPG similarly. He assumed *no* IPG programming aired on stations where IPG-represented programs likely were carried on those stations. As to the 335 stations-years which appeared only in the MPAA samples, Dr. Cowan credited only MPAA with programming and assumed that IPG had *no* programming on those stations. IPG had programming on all but 15 of the remaining 768 stations-years (*i.e.*, the total of the other two data sets, 298 plus 470), but Dr. Cowan similarly (and erroneously) did not attempt to identify IPG programming on stations in the MPAA-only-stations sample.

C. Dr. Cowan Relied on a Flawed Combination of Two Samples Generating Unreliable Satellite Data.

57. Dr. Cowan followed a similarly-flawed methodology when he combined IPG and MPAA satellite data as he did when he combined the IPG and MPAA cable data. He combined the IPG data that consisted of samples of distantly retransmitted signals carried by satellite systems each year from 1999 to 2009, with the MPAA data that consisted of samples of distantly retransmitted signals carried by satellite systems each year from 2000 to 2009.^{38, 39}

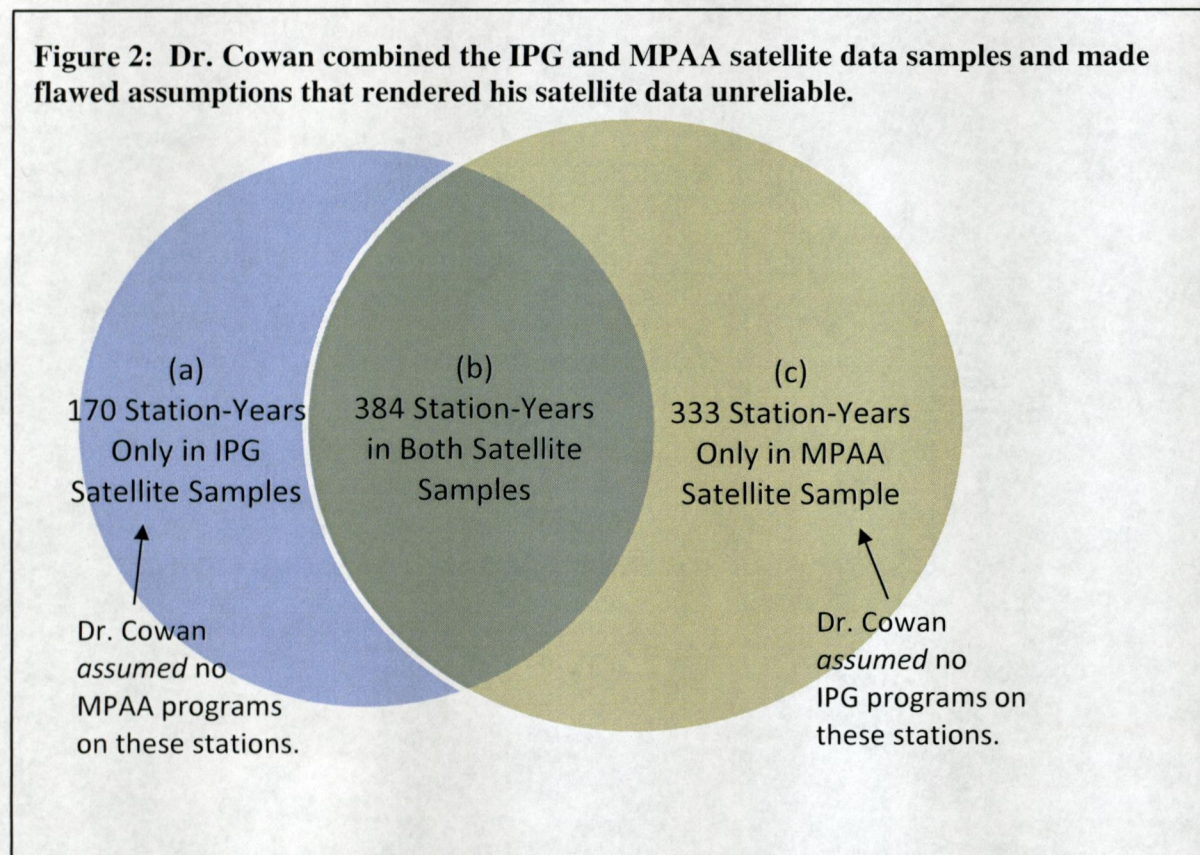
³⁸ I understand that the Program Suppliers royalty share allocations for the 1999 satellite royalty year have been settled among all parties and are not at issue in this Proceeding.

³⁹ The MPAA data for the years 2007-2009 included all distantly retransmitted stations carried by satellite systems.

58. This combination of the IPG and MPAA satellite data created three sets of satellite stations-years samples: (a) 170 stations-years only in the IPG samples; (b) 384 stations-years that were in both the IPG and the MPAA samples (the Robinson Overlap); and (c) 333 stations-years only in the MPAA samples.

59. Figure 2 below is a graphical representation of Dr. Cowan's three types of satellite stations-years data. The blue circle on the left represents the IPG satellite data and the green circle on the right represents the MPAA satellite data. There was a total of 887 stations-years combinations in Dr. Cowan's three sets of 1999-2009 satellite samples.

Figure 2: Dr. Cowan combined the IPG and MPAA satellite data samples and made flawed assumptions that rendered his satellite data unreliable.



60. For his satellite analysis, as with his cable analysis, Dr. Cowan credited programming only to IPG on stations-years that appeared only in IPG's stations samples and assumed that MPAA had no programs on those IPG-sample-only stations. Similarly, he credited programming only to MPAA on MPAA-sample-only stations and assumed that IPG had no programs on those MPAA-sample-only stations. He made no attempt to identify additional programming for either party in those instances. His assumption in both cases that no programming existed was without apparent basis.

D. Dr. Cowan's Combination of Two Samples Generated Unreliable Cable and Satellite Results.

61. Dr. Cowan's assumptions (a) that there were no IPG programs either on the 335 stations MPAA-sample-only cable stations or on the 333 MPAA-sample-only satellite stations and (b) that there were no MPAA programs on the 470 IPG-sample-only cable stations or on the 170 IPG-sample-only satellite stations made his data unreliable because those assumptions are unreasonable in light of the evidence of claimed programming on all stations across all royalty years.

62. To illustrate the unreasonableness of Dr. Cowan's assumptions in combining the IPG and MPAA data sets, consider a hypothetical market where 10 IPG programs and 200 MPAA programs were carried on every distantly retransmitted station. Suppose further that IPG's sample in a royalty year included stations *A* and *B* whereas MPAA's sample in the same year included stations *B* and *C*. MPAA's data would include all its claimed titles carried on stations *B* and *C*, and IPG's data would include all its claimed titles on stations *A* and *B*.

63. Under Dr. Cowan's approach, he would simply combine the two data sets and incorrectly assume: 10 IPG programs and 0 MPAA programs on station *A*, 10 IPG programs and 200 MPAA programs on station *B*, and 0 IPG programs and 200 MPAA programs on station *C*. That is, he

would construct wrong data for the two stations not in both the IPG and MPAA samples, stations A and C. He then used this wrong data to perform his regressions and calculate his royalty shares. Dr. Cowan could have used information concerning MPAA claimed titles on stations B and C to identify MPAA programming on station A. Similarly, Dr. Cowan could have attempted to identify IPG claimed program titles on station C. Dr. Cowan made no such effort.

64. By crediting MPAA with no programming and vice versa in the foregoing instances, Dr. Cowan effectively created artificial losses of programming in some of the years.

65. Table 1 below presents an example from Dr. Cowan's underlying data for the station WSEE carried by satellite systems over the 1999 to 2009 royalty years.

Table 1: Dr. Cowan's Data Indicate his Methodology and Its Application are Unreliable. Example from Satellite Royalty Years.					
<i>Call Sign</i>	<i>Year</i>	<i># of IPG Programs</i>	<i># of MPAA Programs</i>	<i>Cowan's % of Progs MPAA</i>	<i>Number of Subscribers</i>
WSEE	1999	1	0*	0%	5,033,223
WSEE	2000	446	6,887	94%	1,951,788
WSEE	2001	431	6,566	94%	1,333,762
WSEE	2002	450	6,259	93%	908,568
WSEE	2003	463	6,628	93%	631,749
WSEE	2004	464	7,196	94%	391,201
WSEE	2005	458	0*	0%	211,361
WSEE	2006	461	0*	0%	67,736
WSEE	2007	0*	7,742	100%	32,575
WSEE	2008	0*	7,563	100%	24,154
WSEE	2009	0*	7,703	100%	1,632
Notes: 0* = not in overlapping data assembled by Cowan (the Robinson Overlap). That is, the station is not in the IPG sample year, and Dr. Cowan assumes zero MPAA programs, or the station is not in the MPAA sample year, and Dr. Cowan assumes zero IPG programs.					

66. Table 1 shows that WSEE experienced a dramatic decline in the number of subscribers reached between 1999 and 2009. During that period, the number of IPG and MPAA programs carried on WSEE was somewhat constant over the satellite royalty years, *for the years the stations were in the IPG or MPAA samples*. Further, between 431 and 464 IPG-claimed programs were carried on WSEE and retransmitted by satellite carriers in the years 2000 to 2006,

but WSEE was not in the IPG sample data for the years 2007 and 2009. Rather than use the information regarding IPG claimed representation of program titles aired on WSEE over 2000 to 2006 (or, information regarding claimed titles that aired on any other station in the data), Dr. Cowan's methodology assumed *no* IPG programs aired on WSEE from 2007 to 2009.

67. Similarly, because WSEE was not in the 2005 or 2006 MPAA samples, Dr. Cowan's methodology assumed *no* MPAA programs aired on WSEE in 2005 or 2006, despite 6,259 to 7,703 MPAA claimed programs that actually aired on WSEE for years WSEE was in the MPAA satellite data. Dr. Cowan made no effort to identify MPAA programming carried by WSEE and retransmitted by satellite systems in 2005 or 2006.

68. Due to Dr. Cowan's erroneous assumptions when combining the IPG and MPAA data, his regression analysis mathematically attributed some of the 1.9 million decline in WSEE's satellite subscribers to his self-created, artificial loss of all IPG programming in 2007-2009 (even while the station's carriage of MPAA increased between 2000 and 2009). Mathematically attributing the decline in WSEE's satellite subscribers to the artificial loss of IPG programs is an erroneous and baseless construct of Dr. Cowan's data analysis.

69. The WSEE example illustrates that Dr. Cowan's regression-based methodology and its application should not be relied upon in allocating royalties. Dr. Cowan assembled data concerning the number of IPG and MPAA programs retransmitted that are wrong. Without foundation, for the cable and satellite royalty years at issue, he assumed no IPG or MPAA programs on many retransmitted stations.⁴⁰ His methodology relying on these flawed data cannot produce reliable royalty allocations.

⁴⁰ Dr. Cowan's regression-based methodology applied to the Robinson Overlap data, where Dr. Cowan had claimed MPAA and IPG programming information, would suggest no program category had a statistically significant impact on the number of cable or satellite subscribers.

E. Dr. Cowan Examined the Wrong Data Regarding the Number of Cable Subscribers.

70. In addition to the data flaws described above, Dr. Cowan failed to examine the impact of the number of IPG and MPAA programs on the number of CSO distant subscribers as he claimed. Dr. Cowan stated that his cable regression examined the impact of the number of MPAA and IPG programs on the logarithm of the number of *distant* subscribers.⁴¹ His cable regression did not do so. I replicated his regression results for cable using his data. My analysis showed that Dr. Cowan's cable results are based on the number of *all* CSO subscribers – that is, local *and* distant subscribers – not just distant subscribers.

71. Dr. Cowan's regression methodology when applied as he stated, indicates no statistically significant impact of IPG Program Suppliers programs and a positive and statistically significant impact of MPAA programs on the logarithm of the number of cable distant subscribers. However, even this finding is a result of a flawed methodology applied to flawed data.

V. CONCLUSION

72. Dr. Cowan's economic theory motivating his model is flawed. Both Dr. Cowan's regression methodology and the old-IPG volume-based methodology are unsound and unreliable. Dr. Cowan's assembled data are flawed and unreliable. As a result, Dr. Cowan's estimates of the marginal value of the number of MPAA and IPG programs and his resulting calculated royalty share allocations as well as the volume-based royalty shares are unreliable.

73. Insofar as the programming at issue in this proceeding were viewed by cable and satellite system customers, they can reasonably be assumed to have been valued by those customers. In their efforts to attract and retain customers, cable and satellite systems value viewed programming. As articulated in my original testimony, a reasonable basis for allocating royalty

⁴¹ Cowan Corrected Amended Report at par. 32.

shares between MPAA and IPG in this proceeding is the estimated viewing shares I reported in my August 2016 testimony.

74. The only adjustment to my recommended royalty share allocations set forth in my August 2016 testimony stems from the crediting of IPG for a specific claimant, as directed by the Judges' October 27, 2016 Order.⁴² This adjustment resulted in a 0.01 percentage point decline in MPAA's 2008 satellite royalty share allocation.

75. Based on the methodology described in my August 2016 testimony, MPAA's cable viewership shares, and therefore reasonable royalty shares of the total cable Program Suppliers royalty pools, are 99.60%, 99.60%, 99.34%, 99.44%, 99.28%, and 99.44% for the years 2004, 2005, 2006, 2007, 2008, and 2009, respectively. IPG shares of the total cable Program Suppliers royalty pools are 0.40%, 0.40%, 0.66%, 0.56%, 0.72%, and 0.56% for the years 2004, 2005, 2006, 2007, 2008, and 2009, respectively.

76. MPAA's calculated satellite viewership shares, and therefore reasonable royalty shares of the total satellite Program Suppliers royalty pools are 99.54%, 99.75%, 99.74%, 99.65%, 99.87%, 99.73%, 99.65%, 99.77%, 99.78%, and 99.57% for the years 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, and 2009, respectively. IPG shares of the total satellite Program Suppliers royalty pools are 0.46%, 0.25%, 0.26%, 0.35%, 0.13%, 0.27%, 0.35%, 0.23%, 0.22%, and 0.43% for the years 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, and 2009, respectively.

⁴² See Gray August 2016 Testimony at par. 49, Table 4. My 2008 satellite share revision was made in response to the Judges' decision to modify the *March 13 Opinion And Ruling* to allow IPG to claim programming for Willie Wilson Productions for the 2008 satellite royalty year in the Program Suppliers category. See *Order Granting IPG Fourth Motion For Modification Of March 13, 2015 Order* at 1-2 (October 27, 2016) ("October 27, 2016 Order"). In addition to the point estimate change to 99.78, the confidence interval for the 2008 satellite royalty share changes to (99.77 – 99.79) after crediting the additional claimant to IPG.

APPENDIX A: PROGRAM VALUE IN DR. COWAN'S ORIGINAL METHODOLOGY

The Cowan Report described a linear regression model and the Cowan Corrected Amended Report described a log-linear regression model used to calculate the relative value of IPG and MPAA programming. An explanation of Dr. Cowan's log-linear regression methodology to calculate royalty shares is contained in this testimony in Section II.A. This Appendix A provides an explanation of Dr. Cowan's methodology using his linear specification as presented in the Cowan Report. Under a linear specification, Dr. Cowan's marginal value equations (2) and (3) are not exponentiated:

$$\text{(Cowan - Equation 2)} \quad A = g * \sum_{cs=1}^{\# \text{ call signs}} \# \text{ IPG ProgSupp shows}_{cs}$$

$$\text{(Cowan - Equation 3)} \quad B = h * \sum_{cs=1}^{\# \text{ call signs}} \# \text{ MPAA shows}_{cs}$$

As with his methodology adopted in the Cowan Corrected Amended Report, Dr. Cowan did not describe how he converted these values into the royalty shares he reported. Based on additional documents provided in discovery, Dr. Cowan's methodology calculated IPG's suggested royalty share each year as $IPG_{value} / (IPG_{value} + MPAA_{value})$, where IPG_{value} and $MPAA_{value}$ are calculated by the formulae below:

$$IPG_{value} = \frac{g * \sum_{cs=1}^{\# \text{ call signs}} \# \text{ IPG ProgSupp Shows}_{cs}}{\# \text{ Call Signs}} + \frac{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ Subscribers}_{cs}}{\# \text{ Call Signs}} \\ + \frac{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ IPG ProgSupp Shows}_{cs}}{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ ProgSupp Shows}_{cs}} * \frac{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ Subscribers}_{cs}}{\# \text{ Call Signs}}$$

$$MPAA_{value} = \frac{h * \sum_{cs=1}^{\# \text{ call signs}} \# \text{ MPAA ProgSupp Shows}_{cs}}{\# \text{ Call Signs}} + \frac{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ Subscribers}_{cs}}{\# \text{ Call Signs}} \\ + \frac{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ MPAA ProgSupp Shows}_{cs}}{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ ProgSupp Shows}_{cs}} * \frac{\sum_{cs=1}^{\# \text{ call signs}} \# \text{ Subscribers}_{cs}}{\# \text{ Call Signs}}$$

Applying his regression to the data provided by IPG, Dr. Cowan's measure of the marginal returns for offering IPG Program Suppliers programming, or "g", was 287.0706; and, "h", his measure of the marginal returns for offering MPAA programming was 2.8135. According to the Cowan data for the 2004 cable royalty year: 45,251 IPG programs and 432,533 MPAA programs retransmitted; 227,934,730 CSO subscribers reached by 190 call signs. Applying the equations above, *IPG value* totaled 1,381,646 and *MPAA value* totaled 2,292,098.

Therefore, Dr. Cowan's 2004 IPG cable royalty share, based on his linear model, was $1,381,646 / (1,381,646 + 2,292,098)$, or 37.61%. This is 25.48 percentage points greater than the 12.13% royalty share resulting from Dr. Cowan's amended methodology. Table A-1 below reports IPG cable and satellite royalty shares by year applying Dr. Cowan's methodologies to his flawed data.

Table A-1: IPG Royalty Shares Based on Cowan's Flawed Methodology and Flawed Data Applying Cowan's Linear and Log-Linear Methodologies.				
	<i>Cable</i>		<i>Satellite</i>	
<i>Royalty Year</i>	<i>Linear</i>	<i>Log-Linear</i>	<i>Linear</i>	<i>Log-Linear</i>
2000	--	--	36.26%	11.14%
2001	--	--	36.22%	9.79%
2002	--	--	36.17%	8.81%
2003	--	--	35.86%	7.08%
2004	37.61%	12.13%	36.40%	5.77%
2005	37.01%	10.46%	35.94%	7.09%
2006	37.53%	12.68%	35.77%	10.64%
2007	37.16%	11.01%	35.47%	12.47%
2008	37.23%	11.38%	35.56%	8.08%
2009	35.58%	6.96%	35.95%	6.69%

Dr. Cowan described his linear and log-linear regressions that contributed to his recommended share allocations as being "exactly the same."⁴³ The calculated allocations presented above are based on Dr. Cowan's regressions and his data. The magnitude of the difference in Dr. Cowan's calculated allocations underscore the unreliability of his methodology.

⁴³ Cowan September 2016 Declaration, at par. 5.

APPENDIX B: REPLICATION OF DR. COWAN'S CABLE & SATELLITE REGRESSIONS

A. Dr. Cowan's Relied-Upon Cable Regression Specification and Estimates

Source	SS	df	MS	Number of obs = 1103		
Model	1523.07735	501	3.04007456	F(501, 601) = 56.36		
Residual	32.4194073	601	.053942441	Prob > F = 0.0000		
				R-squared = 0.9792		
				Adj R-squared = 0.9618		
Total	1555.49676	1102	1.41152156	Root MSE = .23226		

Log of Subs	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
num_programs_DEV_IPG	.0002613	.0002817	0.93	0.354	-.000292	.0008146
num_programs_DEV_SDC	-4.33e-06	.0000965	-0.04	0.964	-.0001939	.0001853
num_programs_MPAA	-5.57e-07	4.85e-06	-0.11	0.909	-.0000101	8.97e-06
num_programs_PS_IPG	.0001246	.0000534	2.33	0.020	.0000197	.0002296
_Iyear_2005	.0313549	.0287199	1.09	0.275	-.0250486	.0877584
_Iyear_2006	.1604141	.0295303	5.43	0.000	.102419	.2184093
_Iyear_2007	.0756455	.0296866	2.55	0.011	.0173436	.1339475
_Iyear_2008	.1496488	.0314979	4.75	0.000	.0877894	.2115081
_Iyear_2009	.5565557	.0310117	17.95	0.000	.4956513	.6174601
_Icall_sign_2	-.9736109	.3300092	-2.95	0.003	-1.621722	-.3254996
_Icall_sign_3	4.6964	.252077	18.63	0.000	4.201341	5.191459
_Icall_sign_4	1.418419	.2517025	5.64	0.000	.9240954	1.912742
_Icall_sign_5	3.041788	.2521198	12.06	0.000	2.546645	3.536931
_Icall_sign_6	3.874388	.2520992	15.37	0.000	3.379286	4.369491
_Icall_sign_7	3.325681	.330841	10.05	0.000	2.675936	3.975426
_Icall_sign_8	4.325531	.2520668	17.16	0.000	3.830492	4.82057
_Icall_sign_9	.8252971	.3300372	2.50	0.013	.1771307	1.473464
_Icall_sign_10	3.151719	.2517992	12.52	0.000	2.657206	3.646233
_Icall_sign_11	.8103417	.2943713	2.75	0.006	.2322204	1.388463
_Icall_sign_12	2.509478	.251814	9.97	0.000	2.014936	3.00402
_Icall_sign_13	.2305998	.3378076	0.68	0.495	-.4328269	.8940265
_Icall_sign_14	3.338522	.28573	11.68	0.000	2.777372	3.899673
_Icall_sign_15	3.823072	.2517226	15.19	0.000	3.328709	4.317435
_Icall_sign_16	3.225784	.2620154	12.31	0.000	2.711207	3.740361
_Icall_sign_17	.0500539	.3744756	0.13	0.894	-.6853859	.7854936
_Icall_sign_18	2.073477	.3299177	6.28	0.000	1.425545	2.721408
_Icall_sign_19	3.519308	.2555944	13.77	0.000	3.017341	4.021274
_Icall_sign_20	5.385744	.2609414	20.64	0.000	4.873276	5.898212
_Icall_sign_21	4.266186	.3301081	12.92	0.000	3.61788	4.914491
_Icall_sign_22	2.964656	.2604564	11.38	0.000	2.453141	3.476172
_Icall_sign_23	5.022408	.3299168	15.22	0.000	4.374478	5.670338
_Icall_sign_24	3.628086	.2518719	14.40	0.000	3.133429	4.122742
_Icall_sign_25	3.175487	.3311991	9.59	0.000	2.525039	3.825935
_Icall_sign_26	2.053747	.3298637	6.23	0.000	1.405921	2.701572
_Icall_sign_27	4.832528	.2648475	18.25	0.000	4.312389	5.352667
_Icall_sign_28	1.776968	.330036	5.38	0.000	1.128804	2.425132
_Icall_sign_29	4.141693	.2709446	15.29	0.000	3.609579	4.673806
_Icall_sign_30	2.596868	.3325812	7.81	0.000	1.943706	3.250031
_Icall_sign_31	5.366256	.2547233	21.07	0.000	4.866	5.866512
_Icall_sign_32	5.394731	.3300396	16.35	0.000	4.74656	6.042902
_Icall_sign_33	2.516104	.3286305	7.66	0.000	1.8707	3.161508
_Icall_sign_34	.6138979	.3416677	1.80	0.073	-.0571098	1.284906
_Icall_sign_35	4.210717	.2605009	16.16	0.000	3.699114	4.722319
_Icall_sign_36	5.598297	.2552656	21.93	0.000	5.096976	6.099618
_Icall_sign_37	1.93839	.3306276	5.86	0.000	1.289065	2.587716
_Icall_sign_38	4.949094	.2518064	19.65	0.000	4.454567	5.443622
_Icall_sign_39	3.355227	.3300557	10.17	0.000	2.707024	4.00343
_Icall_sign_40	3.840227	.285926	13.43	0.000	3.278691	4.401762

_Icall_sign_41	1.156497	.3302278	3.50	0.000	.5079564	1.805038
_Icall_sign_42	4.059961	.2695299	15.06	0.000	3.530626	4.589296
_Icall_sign_43	4.886835	.2604134	18.77	0.000	4.375404	5.398265
_Icall_sign_44	1.569572	.3301029	4.75	0.000	.921277	2.217868
_Icall_sign_45	3.685609	.2859516	12.89	0.000	3.124023	4.247195
_Icall_sign_46	2.585865	.3325492	7.78	0.000	1.932766	3.238965
_Icall_sign_47	3.814831	.3298868	11.56	0.000	3.16696	4.462702
_Icall_sign_48	1.930037	.3299654	5.85	0.000	1.282012	2.578063
_Icall_sign_49	3.375997	.3301072	10.23	0.000	2.727694	4.024301
_Icall_sign_50	2.995778	.2862961	10.46	0.000	2.433515	3.55804
_Icall_sign_51	4.461439	.3300906	13.52	0.000	3.813167	5.10971
_Icall_sign_52	2.652185	.3302167	8.03	0.000	2.003666	3.300704
_Icall_sign_53	3.414734	.2689071	12.70	0.000	2.886622	3.942846
_Icall_sign_54	2.45772	.3357342	7.32	0.000	1.798366	3.117075
_Icall_sign_55	5.329924	.3303202	16.14	0.000	4.681202	5.978646
_Icall_sign_56	2.684659	.3299411	8.14	0.000	2.036681	3.32636
_Icall_sign_57	2.463307	.2858413	8.62	0.000	1.901937	3.024676
_Icall_sign_58	2.179552	.2848931	7.65	0.000	1.620045	2.739059
_Icall_sign_59	4.884987	.2518591	19.40	0.000	4.390356	5.379618
_Icall_sign_60	3.869078	.2857727	13.54	0.000	3.307843	4.430312
_Icall_sign_61	4.835088	.3298897	14.66	0.000	4.187211	5.482965
_Icall_sign_62	.682485	.3301824	2.07	0.039	.0340334	1.330936
_Icall_sign_63	4.945385	.2533439	19.52	0.000	4.447838	5.442932
_Icall_sign_64	2.354315	.3299655	7.14	0.000	1.706289	3.00234
_Icall_sign_65	4.453173	.3299141	13.50	0.000	3.805249	5.101098
_Icall_sign_66	4.504234	.2858319	15.76	0.000	3.942883	5.065585
_Icall_sign_67	.6994789	.3298549	2.12	0.034	.0516705	1.347287
_Icall_sign_68	.6047819	.2848856	2.12	0.034	.0452896	1.164274
_Icall_sign_69	2.97406	.33005	9.01	0.000	2.325869	3.622251
_Icall_sign_70	1.911518	.3303254	5.79	0.000	1.262786	2.56025
_Icall_sign_71	2.290091	.3300749	6.94	0.000	1.64185	2.938331
_Icall_sign_72	.8931609	.2906156	3.07	0.002	.3224155	1.463906
_Icall_sign_73	3.972433	.2694875	14.74	0.000	3.443182	4.501685
_Icall_sign_74	3.81119	.2851737	13.36	0.000	3.251131	4.371248
_Icall_sign_75	4.263145	.2703842	15.77	0.000	3.732133	4.794158
_Icall_sign_76	1.629404	.2874656	5.67	0.000	1.064845	2.193963
_Icall_sign_77	3.333205	.3299151	10.10	0.000	2.685278	3.981131
_Icall_sign_78	5.39913	.2604786	20.73	0.000	4.887571	5.910689
_Icall_sign_79	1.22585	.3359751	3.65	0.000	.5660217	1.885678
_Icall_sign_80	2.889114	.3300331	8.75	0.000	2.240956	3.537272
_Icall_sign_81	4.222519	.3301262	12.79	0.000	3.574178	4.87086
_Icall_sign_82	2.946647	.2849202	10.34	0.000	2.387087	3.506207
_Icall_sign_83	1.345729	.3300909	4.08	0.000	.6974571	1.994001
_Icall_sign_84	3.810152	.3298656	11.55	0.000	3.162322	4.457981
_Icall_sign_85	4.359565	.2955415	14.75	0.000	3.779145	4.939985
_Icall_sign_86	3.974949	.2858936	13.90	0.000	3.413477	4.536421
_Icall_sign_87	3.212517	.2695605	11.92	0.000	2.683122	3.741912
_Icall_sign_88	2.937869	.3300481	8.90	0.000	2.289681	3.586057
_Icall_sign_89	2.825113	.3300309	8.56	0.000	2.176959	3.473267
_Icall_sign_90	2.559047	.3299753	7.76	0.000	1.911002	3.207092
_Icall_sign_91	4.577832	.3300446	13.87	0.000	3.929651	5.226013
_Icall_sign_92	1.572956	.2864432	5.49	0.000	1.010404	2.135507
_Icall_sign_93	3.04829	.3361833	9.07	0.000	2.388053	3.708527
_Icall_sign_94	2.308173	.3287223	7.02	0.000	1.662589	2.953757
_Icall_sign_95	3.735413	.273043	13.68	0.000	3.199178	4.271647
_Icall_sign_96	4.332449	.3301278	13.12	0.000	3.684105	4.980793
_Icall_sign_97	1.816077	.3302818	5.50	0.000	1.16743	2.464724
_Icall_sign_98	4.819007	.2617077	18.41	0.000	4.305034	5.332979
_Icall_sign_99	3.716297	.3360828	11.06	0.000	3.056258	4.376337
_Icall_sign_100	2.222258	.3285617	6.76	0.000	1.576989	2.867526
_Icall_sign_101	3.866965	.2864669	13.50	0.000	3.304367	4.429562
_Icall_sign_102	2.531957	.3312549	7.64	0.000	1.881399	3.182515
_Icall_sign_103	1.184372	.3301707	3.59	0.000	.5359439	1.832801

Icall_sign_104	1.727083	.3299822	5.23	0.000	1.079024	2.375141
Icall_sign_105	-.649267	.330646	-1.96	0.050	-1.298629	.0000949
Icall_sign_106	4.91646	.3299149	14.90	0.000	4.268533	5.564386
Icall_sign_107	1.863546	.3306497	5.64	0.000	1.214177	2.512915
Icall_sign_108	4.121579	.3287959	12.54	0.000	3.47585	4.767307
Icall_sign_109	1.404549	.3299524	4.26	0.000	.7565496	2.052549
Icall_sign_110	3.713723	.2604737	14.26	0.000	3.202174	4.225272
Icall_sign_111	2.102567	.3300676	6.37	0.000	1.454341	2.750793
Icall_sign_112	3.86798	.2694776	14.35	0.000	3.338748	4.397212
Icall_sign_113	3.127116	.2852387	10.96	0.000	2.56693	3.687302
Icall_sign_114	2.08309	.3302406	6.31	0.000	1.434525	2.731656
Icall_sign_115	3.976745	.2929266	13.58	0.000	3.401461	4.552029
Icall_sign_116	4.268142	.2858138	14.93	0.000	3.706827	4.829457
Icall_sign_117	1.080237	.3299279	3.27	0.001	.4322849	1.728188
Icall_sign_118	4.459144	.2932093	15.21	0.000	3.883304	5.034983
Icall_sign_119	1.637689	.2852507	5.74	0.000	1.07748	2.197899
Icall_sign_120	2.846527	.330035	8.62	0.000	2.198365	3.494689
Icall_sign_121	3.09438	.2858078	10.83	0.000	2.533077	3.655684
Icall_sign_122	5.688121	.2567934	22.15	0.000	5.183799	6.192442
Icall_sign_123	5.070146	.2517633	20.14	0.000	4.575704	5.564589
Icall_sign_124	3.496764	.3299781	10.60	0.000	2.848713	4.144814
Icall_sign_125	4.426842	.2858222	15.49	0.000	3.86551	4.988174
Icall_sign_126	1.695995	.2863973	5.92	0.000	1.133534	2.258456
Icall_sign_127	4.98091	.2860094	17.42	0.000	4.419211	5.54261
Icall_sign_128	4.22203	.2851781	14.80	0.000	3.661963	4.782096
Icall_sign_129	3.600079	.285773	12.60	0.000	3.038844	4.161315
Icall_sign_130	4.17627	.3302744	12.64	0.000	3.527638	4.824902
Icall_sign_131	2.447743	.3304265	7.41	0.000	1.798812	3.096674
Icall_sign_132	4.996034	.2522984	19.80	0.000	4.50054	5.491528
Icall_sign_133	3.729592	.3317195	11.24	0.000	3.078122	4.381063
Icall_sign_134	1.328054	.2608894	5.09	0.000	.8156879	1.840419
Icall_sign_135	4.32286	.2871862	15.05	0.000	3.75885	4.886871
Icall_sign_136	2.103743	.332144	6.33	0.000	1.45144	2.756047
Icall_sign_137	3.957569	.3301195	11.99	0.000	3.309241	4.605897
Icall_sign_138	1.150117	.3300539	3.48	0.001	.5019179	1.798316
Icall_sign_139	4.222284	.2605695	16.20	0.000	3.710547	4.734022
Icall_sign_140	4.569913	.2862053	15.97	0.000	4.007829	5.131997
Icall_sign_141	2.881183	.3299972	8.73	0.000	2.233096	3.529271
Icall_sign_142	2.535635	.3299945	7.68	0.000	1.887553	3.183718
Icall_sign_143	2.705252	.3995915	6.77	0.000	1.920487	3.490018
Icall_sign_144	3.301648	.3305088	9.99	0.000	2.652555	3.95074
Icall_sign_145	2.110798	.2957886	7.14	0.000	1.529893	2.691703
Icall_sign_146	2.715251	.3299649	8.23	0.000	2.067227	3.363275
Icall_sign_147	4.293449	.2544595	16.87	0.000	3.793711	4.793186
Icall_sign_148	2.589535	.351809	7.36	0.000	1.898611	3.280459
Icall_sign_149	2.382928	.3321592	7.17	0.000	1.730594	3.035262
Icall_sign_150	3.016145	.2849436	10.59	0.000	2.456539	3.575751
Icall_sign_151	3.398226	.2696915	12.60	0.000	2.868574	3.927878
Icall_sign_152	3.532443	.3300697	10.70	0.000	2.884213	4.180673
Icall_sign_153	1.859798	.3335795	5.58	0.000	1.204675	2.514921
Icall_sign_154	2.546609	.3301074	7.71	0.000	1.898305	3.194914
Icall_sign_155	4.152548	.285794	14.53	0.000	3.591271	4.713824
Icall_sign_156	1.704494	.2698991	6.32	0.000	1.174434	2.234554
Icall_sign_157	3.937483	.2517671	15.64	0.000	3.443033	4.431933
Icall_sign_158	3.350713	.3393036	9.88	0.000	2.684348	4.017078
Icall_sign_159	1.155767	.3303317	3.50	0.001	.5070223	1.804512
Icall_sign_160	1.125657	.3301928	3.41	0.001	.4771851	1.774129
Icall_sign_161	5.022051	.2605085	19.28	0.000	4.510434	5.533669
Icall_sign_162	1.030834	.3299571	3.12	0.002	.3828248	1.678843
Icall_sign_163	2.520672	.2690535	9.37	0.000	1.992273	3.049072
Icall_sign_164	3.038397	.2611218	11.64	0.000	2.525575	3.551219
Icall_sign_165	2.549331	.3299272	7.73	0.000	1.90138	3.197281
Icall_sign_166	2.863109	.3300012	8.68	0.000	2.215014	3.511205

Icall_sign_167	6.122115	.2694868	22.72	0.000	5.592864	6.651365
Icall_sign_168	2.985678	.3284992	9.09	0.000	2.340533	3.630824
Icall_sign_169	3.670901	.3316978	11.07	0.000	3.019473	4.322328
Icall_sign_170	3.458013	.2857577	12.10	0.000	2.896808	4.019218
Icall_sign_171	2.987087	.2857712	10.45	0.000	2.425856	3.548319
Icall_sign_172	2.207719	.3294288	6.70	0.000	1.560747	2.85469
Icall_sign_173	3.316933	.2517817	13.17	0.000	2.822454	3.811412
Icall_sign_174	1.948531	.3304649	5.90	0.000	1.299525	2.597537
Icall_sign_175	4.159442	.2694906	15.43	0.000	3.630185	4.6887
Icall_sign_176	3.070614	.3302125	9.30	0.000	2.422103	3.719124
Icall_sign_177	3.02007	.3376056	8.95	0.000	2.35704	3.6831
Icall_sign_178	2.227099	.3298642	6.75	0.000	1.579272	2.874925
Icall_sign_179	5.19359	.3360993	15.45	0.000	4.533519	5.853662
Icall_sign_180	2.57615	.3287342	7.84	0.000	1.930543	3.221758
Icall_sign_181	3.650174	.2694599	13.55	0.000	3.120977	4.179372
Icall_sign_182	3.844517	.2920396	13.16	0.000	3.270975	4.418059
Icall_sign_183	2.573745	.2871861	8.96	0.000	2.009735	3.137756
Icall_sign_184	4.636333	.2553079	18.16	0.000	4.134929	5.137737
Icall_sign_185	1.730639	.330028	5.24	0.000	1.082491	2.378787
Icall_sign_186	5.187936	.2860068	18.14	0.000	4.626242	5.74963
Icall_sign_187	4.420117	.3327804	13.28	0.000	3.766563	5.073671
Icall_sign_188	3.266869	.3321907	9.83	0.000	2.614473	3.919264
Icall_sign_189	4.762789	.2932354	16.24	0.000	4.186899	5.33868
Icall_sign_190	3.610682	.2707691	13.33	0.000	3.078914	4.142451
Icall_sign_191	1.86535	.2695926	6.92	0.000	1.335892	2.394808
Icall_sign_192	1.535441	.3308812	4.64	0.000	.8856167	2.185264
Icall_sign_193	2.692386	.3308295	8.14	0.000	2.042664	3.342109
Icall_sign_194	2.805999	.3345738	8.39	0.000	2.148924	3.463075
Icall_sign_195	3.834025	.3298813	11.62	0.000	3.186164	4.481885
Icall_sign_196	4.6192	.2518128	18.34	0.000	4.12466	5.113739
Icall_sign_197	3.344252	.260366	12.84	0.000	2.832914	3.85559
Icall_sign_198	4.797293	.2935922	16.34	0.000	4.220702	5.373885
Icall_sign_199	4.027738	.2701475	14.91	0.000	3.497191	4.558286
Icall_sign_200	3.48711	.2616522	13.33	0.000	2.973246	4.000974
Icall_sign_201	3.978658	.3300224	12.06	0.000	3.330521	4.626796
Icall_sign_202	3.47833	.2610849	13.32	0.000	2.96558	3.99108
Icall_sign_203	2.621306	.330101	7.94	0.000	1.973015	3.269598
Icall_sign_204	4.500429	.2695277	16.70	0.000	3.971098	5.029759
Icall_sign_205	3.104247	.3365063	9.22	0.000	2.443376	3.765118
Icall_sign_206	3.10224	.3331695	9.31	0.000	2.447922	3.756558
Icall_sign_207	5.144634	.2610376	19.71	0.000	4.631977	5.657291
Icall_sign_208	5.506279	.2552955	21.57	0.000	5.004899	6.007658
Icall_sign_209	3.95308	.2609846	15.15	0.000	3.440527	4.465632
Icall_sign_210	3.725961	.3314109	11.24	0.000	3.075097	4.376825
Icall_sign_211	4.321931	.2694802	16.04	0.000	3.792694	4.851168
Icall_sign_212	1.945532	.3318687	5.86	0.000	1.293769	2.597295
Icall_sign_213	3.681588	.2862231	12.86	0.000	3.119469	4.243707
Icall_sign_214	4.670862	.2605316	17.93	0.000	4.159199	5.182525
Icall_sign_215	4.037429	.2857104	14.13	0.000	3.476317	4.598541
Icall_sign_216	5.038264	.2926181	17.22	0.000	4.463586	5.612943
Icall_sign_217	3.238882	.3299476	9.82	0.000	2.590891	3.886872
Icall_sign_218	4.04909	.3288112	12.31	0.000	3.403332	4.694849
Icall_sign_219	5.304137	.2609451	20.33	0.000	4.791662	5.816612
Icall_sign_220	3.044845	.33265	9.15	0.000	2.391548	3.698143
Icall_sign_221	3.687257	.3386358	10.89	0.000	3.022203	4.35231
Icall_sign_222	3.637737	.2619975	13.88	0.000	3.123196	4.152279
Icall_sign_223	1.948478	.3300518	5.90	0.000	1.300283	2.596673
Icall_sign_224	3.797248	.2608465	14.56	0.000	3.284967	4.309529
Icall_sign_225	4.757917	.2737939	17.38	0.000	4.220208	5.295626
Icall_sign_226	4.734371	.2571896	18.41	0.000	4.229271	5.23947
Icall_sign_227	3.356466	.2866951	11.71	0.000	2.79342	3.919511
Icall_sign_228	4.785277	.2518526	19.00	0.000	4.290659	5.279895
Icall_sign_229	3.788229	.2850359	13.29	0.000	3.228442	4.348017

Icall_sign_230	3.665674	.3299377	11.11	0.000	3.017703	4.313645
Icall_sign_231	3.605435	.2541041	14.19	0.000	3.106395	4.104475
Icall_sign_232	2.662038	.3355971	7.93	0.000	2.002952	3.321123
Icall_sign_233	2.839227	.3305308	8.59	0.000	2.190091	3.488363
Icall_sign_234	3.119447	.3301288	9.45	0.000	2.471101	3.767793
Icall_sign_235	3.91043	.3302294	11.84	0.000	3.261886	4.558973
Icall_sign_236	2.45075	.2702947	9.07	0.000	1.919913	2.981587
Icall_sign_237	4.787373	.2859049	16.74	0.000	4.225879	5.348867
Icall_sign_238	3.353291	.2697049	12.43	0.000	2.823612	3.88297
Icall_sign_239	4.368028	.2518013	17.35	0.000	3.873511	4.862546
Icall_sign_240	4.403474	.3299286	13.35	0.000	3.755521	5.051427
Icall_sign_241	3.695555	.269095	13.73	0.000	3.167074	4.224036
Icall_sign_242	5.186395	.2518798	20.59	0.000	4.691724	5.681067
Icall_sign_243	2.717401	.3179776	8.55	0.000	2.092919	3.341883
Icall_sign_244	2.935611	.3311954	8.86	0.000	2.28517	3.586052
Icall_sign_245	3.060216	.3363693	9.10	0.000	2.399614	3.720818
Icall_sign_246	3.428908	.2874489	11.93	0.000	2.864381	3.993434
Icall_sign_247	3.541223	.3300941	10.73	0.000	2.892945	4.189501
Icall_sign_248	4.82091	.3301222	14.60	0.000	4.172576	5.469243
Icall_sign_249	4.376434	.2630413	16.64	0.000	3.859842	4.893026
Icall_sign_250	4.81507	.3301208	14.59	0.000	4.166739	5.4634
Icall_sign_251	1.764134	.3301413	5.34	0.000	1.115764	2.412505
Icall_sign_252	3.314468	.287379	11.53	0.000	2.750079	3.878857
Icall_sign_253	1.854185	.329984	5.62	0.000	1.206123	2.502247
Icall_sign_254	5.111847	.2866778	17.83	0.000	4.548835	5.67486
Icall_sign_255	3.620464	.3299347	10.97	0.000	2.972499	4.268429
Icall_sign_256	4.07403	.2694274	15.12	0.000	3.544896	4.603163
Icall_sign_257	4.575605	.2696265	16.97	0.000	4.04608	5.105129
Icall_sign_258	3.164886	.3299384	9.59	0.000	2.516914	3.812858
Icall_sign_259	3.361866	.2857339	11.77	0.000	2.800707	3.923024
Icall_sign_260	7.86507	.2517211	31.25	0.000	7.37071	8.35943
Icall_sign_261	3.945717	.2868075	13.76	0.000	3.38245	4.508984
Icall_sign_262	2.896439	.3310657	8.75	0.000	2.246253	3.546625
Icall_sign_263	4.838834	.3562977	13.58	0.000	4.139095	5.538574
Icall_sign_264	2.123821	.2862089	7.42	0.000	1.56173	2.685912
Icall_sign_265	2.924278	.3301384	8.86	0.000	2.275913	3.572643
Icall_sign_266	3.00947	.3284935	9.16	0.000	2.364335	3.654605
Icall_sign_267	3.20741	.3316355	9.67	0.000	2.556105	3.858715
Icall_sign_268	5.253979	.2850219	18.43	0.000	4.694219	5.813739
Icall_sign_269	3.54133	.3301988	10.72	0.000	2.892847	4.189814
Icall_sign_270	4.157808	.2859731	14.54	0.000	3.59618	4.719436
Icall_sign_271	3.087212	.2879884	10.72	0.000	2.521626	3.652798
Icall_sign_272	3.406103	.3167743	10.75	0.000	2.783984	4.028222
Icall_sign_273	3.00781	.3299571	9.12	0.000	2.359801	3.655819
Icall_sign_274	2.417721	.2849153	8.49	0.000	1.858171	2.977272
Icall_sign_275	3.075039	.3301996	9.31	0.000	2.426554	3.723525
Icall_sign_276	3.603574	.2859354	12.60	0.000	3.042021	4.165128
Icall_sign_277	3.567777	.2850603	12.52	0.000	3.007942	4.127613
Icall_sign_278	3.274053	.2605938	12.56	0.000	2.762268	3.785838
Icall_sign_279	2.174555	.3299595	6.59	0.000	1.526542	2.822569
Icall_sign_280	1.812995	.2859466	6.34	0.000	1.251419	2.374571
Icall_sign_281	2.600059	.2858334	9.10	0.000	2.038705	3.161412
Icall_sign_282	3.734933	.2617571	14.27	0.000	3.220864	4.249003
Icall_sign_283	3.39804	.3301663	10.29	0.000	2.74962	4.04646
Icall_sign_284	4.041093	.285929	14.13	0.000	3.479552	4.602635
Icall_sign_285	4.308293	.2518224	17.11	0.000	3.813734	4.802852
Icall_sign_286	3.44328	.2857846	12.05	0.000	2.882022	4.004538
Icall_sign_287	4.010326	.2517577	15.93	0.000	3.515894	4.504758
Icall_sign_288	3.81219	.2604258	14.64	0.000	3.300735	4.323645
Icall_sign_289	3.799659	.2850415	13.33	0.000	3.23986	4.359457
Icall_sign_290	2.651704	.3022021	8.77	0.000	2.058204	3.245205
Icall_sign_291	3.180777	.3285064	9.68	0.000	2.535617	3.825937
Icall_sign_292	2.524155	.3299878	7.65	0.000	1.876086	3.172225

Icall_sign_293	1.633786	.3310781	4.93	0.000	.9835751	2.283996
Icall_sign_294	4.709751	.330076	14.27	0.000	4.061509	5.357994
Icall_sign_295	2.568828	.33007	7.78	0.000	1.920597	3.217059
Icall_sign_296	4.662353	.2628229	17.74	0.000	4.146191	5.178516
Icall_sign_297	4.715803	.353984	13.32	0.000	4.020607	5.410999
Icall_sign_298	4.4409	.2517862	17.64	0.000	3.946412	4.935388
Icall_sign_299	.4577886	.3301487	1.39	0.166	-.1905968	1.106174
Icall_sign_300	3.314255	.3299538	10.04	0.000	2.666252	3.962257
Icall_sign_301	5.152274	.2597475	19.84	0.000	4.642151	5.662397
Icall_sign_302	4.124106	.330184	12.49	0.000	3.475652	4.772561
Icall_sign_303	4.910486	.260424	18.86	0.000	4.399034	5.421938
Icall_sign_304	3.34258	.3144039	10.63	0.000	2.725116	3.960044
Icall_sign_305	3.940391	.2553609	15.43	0.000	3.438883	4.441899
Icall_sign_306	3.337535	.2694668	12.39	0.000	2.808325	3.866746
Icall_sign_307	3.225419	.3299642	9.78	0.000	2.577396	3.873442
Icall_sign_308	3.924335	.2864595	13.70	0.000	3.361751	4.486918
Icall_sign_309	1.702939	.347976	4.89	0.000	1.019542	2.386335
Icall_sign_310	3.802791	.260406	14.60	0.000	3.291375	4.314207
Icall_sign_311	3.193364	.28853	11.07	0.000	2.626715	3.760013
Icall_sign_312	3.530876	.3284802	10.75	0.000	2.885768	4.175985
Icall_sign_313	3.619958	.3364203	10.76	0.000	2.959256	4.28066
Icall_sign_314	4.966656	.2857292	17.38	0.000	4.405507	5.527806
Icall_sign_315	4.199776	.3316024	12.67	0.000	3.548536	4.851016
Icall_sign_316	3.630474	.3285755	11.05	0.000	2.985179	4.27577
Icall_sign_317	3.581197	.331328	10.81	0.000	2.930496	4.231898
Icall_sign_318	4.243571	.3286982	12.91	0.000	3.598034	4.889107
Icall_sign_319	3.379522	.3197502	10.57	0.000	2.751559	4.007486
Icall_sign_320	3.802691	.2717734	13.99	0.000	3.26895	4.336432
Icall_sign_321	5.189375	.2858046	18.16	0.000	4.628078	5.750672
Icall_sign_322	4.486078	.3301292	13.59	0.000	3.837731	5.134425
Icall_sign_323	5.693621	.2848923	19.99	0.000	5.134116	6.253127
Icall_sign_324	3.057952	.2858405	10.70	0.000	2.496584	3.61932
Icall_sign_325	3.389095	.2690411	12.60	0.000	2.86072	3.91747
Icall_sign_326	5.044811	.3299604	15.29	0.000	4.396796	5.692827
Icall_sign_327	2.543833	.3299317	7.71	0.000	1.895874	3.191792
Icall_sign_328	2.450019	.3324212	7.37	0.000	1.797171	3.102867
Icall_sign_329	1.888628	.3309628	5.71	0.000	1.238643	2.538612
Icall_sign_330	3.02503	.28508	10.61	0.000	2.465156	3.584905
Icall_sign_331	3.340254	.3285562	10.17	0.000	2.694996	3.985512
Icall_sign_332	3.469014	.328462	10.56	0.000	2.823941	4.114087
Icall_sign_333	4.181931	.3300462	12.67	0.000	3.533747	4.830115
Icall_sign_334	4.488633	.3334128	13.46	0.000	3.833838	5.143429
Icall_sign_335	3.322108	.2733695	12.15	0.000	2.785233	3.858984
Icall_sign_336	2.726956	.3351372	8.14	0.000	2.068774	3.385139
Icall_sign_337	6.271915	.2519969	24.89	0.000	5.777013	6.766816
Icall_sign_338	4.093205	.3286099	12.46	0.000	3.447842	4.738568
Icall_sign_339	3.085554	.2521989	12.23	0.000	2.590256	3.580853
Icall_sign_340	3.859105	.330931	11.66	0.000	3.209183	4.509027
Icall_sign_341	3.39385	.2849347	11.91	0.000	2.834262	3.953439
Icall_sign_342	4.114475	.285791	14.40	0.000	3.553204	4.675745
Icall_sign_343	2.906345	.3300218	8.81	0.000	2.258209	3.554481
Icall_sign_344	3.967133	.3334448	11.90	0.000	3.312275	4.621992
Icall_sign_345	4.112484	.3325642	12.37	0.000	3.459355	4.765614
Icall_sign_346	3.893868	.3300706	11.80	0.000	3.245636	4.542099
Icall_sign_347	4.395543	.2865851	15.34	0.000	3.832713	4.958373
Icall_sign_348	4.11603	.2727151	15.09	0.000	3.58044	4.65162
Icall_sign_349	3.663313	.3299913	11.10	0.000	3.015237	4.31139
Icall_sign_350	6.154049	.2537842	24.25	0.000	5.655637	6.652461
Icall_sign_351	3.538275	.286242	12.36	0.000	2.976119	4.100431
Icall_sign_352	3.266254	.3286185	9.94	0.000	2.620874	3.911634
Icall_sign_353	3.553381	.285759	12.43	0.000	2.992173	4.114588
Icall_sign_354	4.001071	.2979612	13.43	0.000	3.4159	4.586243
Icall_sign_355	4.193321	.261305	16.05	0.000	3.68014	4.706503

Icall_sign_356	2.919603	.3298999	8.85	0.000	2.271707	3.5675
Icall_sign_357	2.210364	.3299721	6.70	0.000	1.562325	2.858402
Icall_sign_358	4.655856	.2635352	17.67	0.000	4.138294	5.173418
Icall_sign_359	5.457063	.2576161	21.18	0.000	4.951126	5.963
Icall_sign_360	6.453824	.2560535	25.20	0.000	5.950955	6.956692
Icall_sign_361	3.325453	.329881	10.08	0.000	2.677593	3.973312
Icall_sign_362	3.74939	.252158	14.87	0.000	3.254172	4.244608
Icall_sign_363	4.283936	.2627847	16.30	0.000	3.767848	4.800024
Icall_sign_364	2.641834	.3299818	8.01	0.000	1.993776	3.289891
Icall_sign_365	2.758516	.2693804	10.24	0.000	2.229474	3.287557
Icall_sign_366	5.48494	.2574435	21.31	0.000	4.979342	5.990538
Icall_sign_367	3.276369	.2553494	12.83	0.000	2.774883	3.777855
Icall_sign_368	3.864352	.3300797	11.71	0.000	3.216102	4.512602
Icall_sign_369	5.414367	.2517892	21.50	0.000	4.919873	5.908861
Icall_sign_370	4.534337	.3364203	13.48	0.000	3.873635	5.195039
Icall_sign_371	4.541258	.3367207	13.49	0.000	3.879966	5.20255
Icall_sign_372	2.774065	.3365739	8.24	0.000	2.113061	3.435069
Icall_sign_373	4.313632	.2611486	16.52	0.000	3.800758	4.826507
Icall_sign_374	3.654756	.2857884	12.79	0.000	3.093491	4.216021
Icall_sign_375	2.381257	.2924566	8.14	0.000	1.806895	2.955618
Icall_sign_376	3.822984	.3353698	11.40	0.000	3.164345	4.481623
Icall_sign_377	3.028114	.2922197	10.36	0.000	2.454218	3.60201
Icall_sign_378	3.110135	.3299069	9.43	0.000	2.462225	3.758046
Icall_sign_379	2.604008	.2858626	9.11	0.000	2.042597	3.165419
Icall_sign_380	2.805251	.3285854	8.54	0.000	2.159936	3.450566
Icall_sign_381	1.808058	.3309193	5.46	0.000	1.15816	2.457957
Icall_sign_382	3.706427	.3299087	11.23	0.000	3.058513	4.354341
Icall_sign_383	2.083384	.3320064	6.28	0.000	1.431351	2.735418
Icall_sign_384	4.623481	.2609536	17.72	0.000	4.110989	5.135973
Icall_sign_385	3.281373	.3299861	9.94	0.000	2.633306	3.929439
Icall_sign_386	2.897408	.3311712	8.75	0.000	2.247015	3.547802
Icall_sign_387	3.600793	.2529672	14.23	0.000	3.103986	4.0976
Icall_sign_388	2.522133	.3312323	7.61	0.000	1.87162	3.172647
Icall_sign_389	4.412691	.3300768	13.37	0.000	3.764447	5.060935
Icall_sign_390	5.695046	.2552173	22.31	0.000	5.19382	6.196272
Icall_sign_391	3.645414	.3299725	11.05	0.000	2.997374	4.293453
Icall_sign_392	4.198535	.3287593	12.77	0.000	3.552878	4.844192
Icall_sign_393	4.165495	.328464	12.68	0.000	3.520418	4.810571
Icall_sign_394	4.545646	.2557857	17.77	0.000	4.043304	5.047989
Icall_sign_395	5.329359	.2560518	20.81	0.000	4.826493	5.832224
Icall_sign_396	3.023541	.2552325	11.85	0.000	2.522285	3.524797
Icall_sign_397	3.894301	.2526581	15.41	0.000	3.398101	4.390501
Icall_sign_398	3.457765	.283261	12.21	0.000	2.901463	4.014067
Icall_sign_399	4.059483	.2550657	15.92	0.000	3.558555	4.560412
Icall_sign_400	2.801714	.3312528	8.46	0.000	2.15116	3.452267
Icall_sign_401	2.627862	.3300069	7.96	0.000	1.979755	3.275969
Icall_sign_402	2.873413	.3322515	8.65	0.000	2.220898	3.525928
Icall_sign_403	2.482917	.3306553	7.51	0.000	1.833537	3.132298
Icall_sign_404	3.698867	.2718097	13.61	0.000	3.165055	4.23268
Icall_sign_405	3.010754	.256609	11.73	0.000	2.506795	3.514713
Icall_sign_406	3.437629	.3306314	10.40	0.000	2.788296	4.086962
Icall_sign_407	3.698321	.2688699	13.76	0.000	3.170282	4.226359
Icall_sign_408	3.732866	.3363666	11.10	0.000	3.072269	4.393462
Icall_sign_409	1.580108	.3291401	4.80	0.000	.9337036	2.226513
Icall_sign_410	3.751585	.3318537	11.30	0.000	3.099851	4.403319
Icall_sign_411	1.818634	.2851222	6.38	0.000	1.258677	2.378591
Icall_sign_412	4.100475	.3322267	12.34	0.000	3.448009	4.752941
Icall_sign_413	4.624816	.2558718	18.07	0.000	4.122305	5.127328
Icall_sign_414	4.443432	.2694727	16.49	0.000	3.914209	4.972654
Icall_sign_415	2.981869	.2858708	10.43	0.000	2.420442	3.543296
Icall_sign_416	4.127573	.2710273	15.23	0.000	3.595297	4.659849
Icall_sign_417	4.918529	.3575837	13.75	0.000	4.216263	5.620794
Icall_sign_418	3.894415	.2949633	13.20	0.000	3.315131	4.473699

Icall_sign_419	2.558465	.3323512	7.70	0.000	1.905754	3.211176
Icall_sign_420	2.626251	.2849422	9.22	0.000	2.066647	3.185854
Icall_sign_421	4.446202	.3299515	13.48	0.000	3.798204	5.0942
Icall_sign_422	3.194322	.346999	9.21	0.000	2.512844	3.8758
Icall_sign_423	3.267127	.3949757	8.27	0.000	2.491426	4.042827
Icall_sign_424	3.971067	.2552926	15.55	0.000	3.469693	4.472441
Icall_sign_425	2.767199	.2858712	9.68	0.000	2.205771	3.328627
Icall_sign_426	4.40573	.3300863	13.35	0.000	3.757467	5.053992
Icall_sign_427	4.438808	.28497	15.58	0.000	3.87915	4.998466
Icall_sign_428	-.5502188	.329927	-1.67	0.096	-1.198169	.097731
Icall_sign_429	2.396086	.3574192	6.70	0.000	1.694143	3.098028
Icall_sign_430	5.030941	.2632076	19.11	0.000	4.514023	5.547859
Icall_sign_431	3.436298	.3344743	10.27	0.000	2.779418	4.093179
Icall_sign_432	4.417979	.2896421	15.25	0.000	3.849146	4.986813
Icall_sign_433	1.735088	.2851805	6.08	0.000	1.175017	2.29516
Icall_sign_434	3.37279	.2859779	11.79	0.000	2.811153	3.934428
Icall_sign_435	4.35113	.2609471	16.67	0.000	3.838651	4.863609
Icall_sign_436	3.826009	.3300351	11.59	0.000	3.177847	4.474172
Icall_sign_437	3.8159	.2859016	13.35	0.000	3.254412	4.377388
Icall_sign_438	4.139467	.2858507	14.48	0.000	3.578079	4.700855
Icall_sign_439	3.113568	.2860996	10.88	0.000	2.551692	3.675445
Icall_sign_440	3.637173	.2859687	12.72	0.000	3.075554	4.198793
Icall_sign_441	4.442354	.2848898	15.59	0.000	3.882854	5.001855
Icall_sign_442	2.558597	.3300411	7.75	0.000	1.910423	3.206771
Icall_sign_443	5.359788	.2553922	20.99	0.000	4.858218	5.861357
Icall_sign_444	4.975496	.2586538	19.24	0.000	4.467521	5.483471
Icall_sign_445	4.091716	.3314283	12.35	0.000	3.440817	4.742614
Icall_sign_446	3.507546	.2859951	12.26	0.000	2.945874	4.069217
Icall_sign_447	5.035837	.3290314	15.31	0.000	4.389646	5.682028
Icall_sign_448	3.57939	.3328378	10.75	0.000	2.925724	4.233057
Icall_sign_449	4.876475	.2609475	18.69	0.000	4.363996	5.388955
Icall_sign_450	5.043605	.3299286	15.29	0.000	4.395652	5.691558
Icall_sign_451	3.810642	.3300967	11.54	0.000	3.162359	4.458925
Icall_sign_452	3.548663	.3327817	10.66	0.000	2.895107	4.20222
Icall_sign_453	4.334206	.3304827	13.11	0.000	3.685165	4.983247
Icall_sign_454	4.828599	.3314584	14.57	0.000	4.177641	5.479556
Icall_sign_455	3.630793	.2986461	12.16	0.000	3.044276	4.21731
Icall_sign_456	3.651705	.2858086	12.78	0.000	3.0904	4.213009
Icall_sign_457	3.016217	.328473	9.18	0.000	2.371123	3.661312
Icall_sign_458	3.221842	.2849979	11.30	0.000	2.66213	3.781555
Icall_sign_459	1.797144	.3303172	5.44	0.000	1.148428	2.445861
Icall_sign_460	3.497129	.2858432	12.23	0.000	2.935757	4.058502
Icall_sign_461	4.147717	.2599397	15.96	0.000	3.637216	4.658217
Icall_sign_462	3.802963	.3299635	11.53	0.000	3.154941	4.450985
Icall_sign_463	2.749336	.3285176	8.37	0.000	2.104154	3.394518
Icall_sign_464	2.442431	.2609801	9.36	0.000	1.929887	2.954975
Icall_sign_465	3.656743	.3301007	11.08	0.000	3.008452	4.305034
Icall_sign_466	3.805215	.2604794	14.61	0.000	3.293654	4.316775
Icall_sign_467	2.744773	.3379572	8.12	0.000	2.081053	3.408494
Icall_sign_468	4.934751	.3300436	14.95	0.000	4.286572	5.58293
Icall_sign_469	3.947826	.2733056	14.44	0.000	3.411076	4.484576
Icall_sign_470	3.413585	.285888	11.94	0.000	2.852124	3.975046
Icall_sign_471	2.629158	.3353673	7.84	0.000	1.970524	3.287792
Icall_sign_472	3.548163	.2688513	13.20	0.000	3.020161	4.076165
Icall_sign_473	6.199063	.2556427	24.25	0.000	5.697001	6.701124
Icall_sign_474	2.626653	.2652046	9.90	0.000	2.105813	3.147493
Icall_sign_475	4.744689	.2857784	16.60	0.000	4.183443	5.305935
Icall_sign_476	3.862862	.3285066	11.76	0.000	3.217701	4.508022
Icall_sign_477	3.23752	.2852053	11.35	0.000	2.6774	3.79764
Icall_sign_478	4.965201	.3299286	15.05	0.000	4.317248	5.613154
Icall_sign_479	4.565335	.2611045	17.48	0.000	4.052547	5.078124
Icall_sign_480	3.883935	.2857391	13.59	0.000	3.322766	4.445103
Icall_sign_481	4.217442	.2546415	16.56	0.000	3.717346	4.717537

_Icall_sign_482	3.183745	.3308781	9.62	0.000	2.533927	3.833562
_Icall_sign_483	5.019001	.2688287	18.67	0.000	4.491043	5.546959
_Icall_sign_484	3.394058	.3312494	10.25	0.000	2.743511	4.044605
_Icall_sign_485	4.433139	.4241634	10.45	0.000	3.600117	5.266162
_Icall_sign_486	1.826582	.3299852	5.54	0.000	1.178517	2.474646
_Icall_sign_487	3.95011	.2691139	14.68	0.000	3.421592	4.478627
_Icall_sign_488	4.31518	.2695418	16.01	0.000	3.785822	4.844538
_Icall_sign_489	3.346335	.3286103	10.18	0.000	2.700971	3.991699
_Icall_sign_490	4.982921	.285863	17.43	0.000	4.42151	5.544333
_Icall_sign_491	3.700485	.3353729	11.03	0.000	3.041839	4.35913
_Icall_sign_492	3.663789	.2724167	13.45	0.000	3.128784	4.198793
_Icall_sign_493	3.488297	.3287351	10.61	0.000	2.842688	4.133906
_cons	9.37991	.2344981	40.00	0.000	8.919374	9.840445

B. Dr. Cowan's Relied-Upon Satellite Regression Specification and Estimates

Source	SS	df	MS	Number of obs = 887		
Model	9903.06691	321	30.8506757	F(321, 565) = 29.73		
Residual	586.218876	565	1.03755553	Prob > F = 0.0000		
				R-squared = 0.9441		
				Adj R-squared = 0.9124		
Total	10489.2858	886	11.838923	Root MSE = 1.0186		

Log of Subs	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
num_programs_DEV_IPG	.0021282	.0024462	0.87	0.385	-.0026765	.006933
num_programs_DEV_SDC	.0040073	.0013228	3.03	0.003	.0014091	.0066056
num_programs_MPAA	.0000598	.0000197	3.04	0.003	.0000211	.0000985
num_programs_PS_IPG	.0007269	.0002575	2.82	0.005	.0002211	.0012327
_Iyear_2000	-1.086224	.2645347	-4.11	0.000	-1.605816	-.5666324
_Iyear_2001	-.6504557	.2571495	-2.53	0.012	-1.155541	-.1453699
_Iyear_2002	-.8840526	.260872	-3.39	0.001	-1.39645	-.3716552
_Iyear_2003	-.7572532	.2706957	-2.80	0.005	-1.288946	-.2255603
_Iyear_2004	-1.120328	.2632341	-4.26	0.000	-1.637365	-.6032913
_Iyear_2005	-.7224345	.2593562	-2.79	0.006	-1.231854	-.2130145
_Iyear_2006	-.8816016	.2470925	-3.57	0.000	-1.366934	-.3962695
_Iyear_2007	-1.337435	.2742726	-4.88	0.000	-1.876154	-.7987167
_Iyear_2008	-1.059832	.2731359	-3.88	0.000	-1.596318	-.5233464
_Iyear_2009	-1.050406	.2694681	-3.90	0.000	-1.579687	-.5211242
_Icall_sign_2	5.840714	.7963011	7.33	0.000	4.276642	7.404786
_Icall_sign_3	1.168262	.9344502	1.25	0.212	-.6671585	3.003682
_Icall_sign_4	-2.719879	.9420352	-2.89	0.004	-4.570198	-.8695605
_Icall_sign_5	-.424912	.9425717	-0.45	0.652	-2.276285	1.426461
_Icall_sign_6	-3.927178	1.261728	-3.11	0.002	-6.405427	-1.448928
_Icall_sign_7	.8657219	1.26407	0.68	0.494	-1.617128	3.348572
_Icall_sign_8	-5.476741	1.258768	-4.35	0.000	-7.949178	-3.004304
_Icall_sign_9	.4279755	1.261203	0.34	0.734	-2.049244	2.905195
_Icall_sign_10	4.563403	1.022124	4.46	0.000	2.555775	6.571031
_Icall_sign_11	-3.38062	1.260578	-2.68	0.008	-5.856612	-.9046284
_Icall_sign_12	5.709917	.790253	7.23	0.000	4.157724	7.262109
_Icall_sign_13	-3.150765	1.262957	-2.49	0.013	-5.63143	-.6701006
_Icall_sign_14	-3.146924	1.261261	-2.50	0.013	-5.624257	-.6695919
_Icall_sign_15	2.679863	.7933332	3.38	0.001	1.121621	4.238106
_Icall_sign_16	.5760982	.9423353	0.61	0.541	-1.27481	2.427006
_Icall_sign_17	4.745937	1.032963	4.59	0.000	2.71702	6.774854
_Icall_sign_18	.766241	.9047725	0.85	0.397	-1.010887	2.543369
_Icall_sign_19	2.080476	.8224192	2.53	0.012	.4651036	3.695848
_Icall_sign_20	.9667904	.8792078	1.10	0.272	-.7601246	2.693705
_Icall_sign_21	.4031776	1.034099	0.39	0.697	-1.627971	2.434326
_Icall_sign_22	-3.350206	1.261741	-2.66	0.008	-5.828482	-.8719309

Icall_sign_23	-4.985014	1.258593	-3.96	0.000	-7.457107	-2.51292
Icall_sign_24	2.462593	.7926887	3.11	0.002	.9056168	4.01957
Icall_sign_25	-2.203255	1.030842	-2.14	0.033	-4.228006	-.1785042
Icall_sign_26	-2.100007	1.030924	-2.04	0.042	-4.124919	-.0750957
Icall_sign_27	-4.10004	1.258592	-3.26	0.001	-6.572131	-1.627949
Icall_sign_28	-1.328717	1.261614	-1.05	0.293	-3.806744	1.149309
Icall_sign_29	1.421352	1.278812	1.11	0.267	-1.090455	3.933158
Icall_sign_30	-3.873607	1.260588	-3.07	0.002	-6.349619	-1.397595
Icall_sign_31	3.585858	.8398036	4.27	0.000	1.93634	5.235376
Icall_sign_32	-1.306139	1.258594	-1.04	0.300	-3.778235	1.165956
Icall_sign_33	-4.159477	1.260506	-3.30	0.001	-6.635327	-1.683627
Icall_sign_34	-6.092897	1.261288	-4.83	0.000	-8.570282	-3.615511
Icall_sign_35	2.198942	.8094589	2.72	0.007	.6090257	3.788858
Icall_sign_36	-2.589582	1.260667	-2.05	0.040	-5.065747	-.1134164
Icall_sign_37	-2.823213	1.262332	-2.24	0.026	-5.30265	-.3437759
Icall_sign_38	-.5125464	1.032596	-0.50	0.620	-2.540742	1.515649
Icall_sign_39	-3.670607	1.258968	-2.92	0.004	-6.143436	-1.197779
Icall_sign_40	-6.383093	1.029382	-6.20	0.000	-8.404975	-4.361211
Icall_sign_41	-5.606257	1.261442	-4.44	0.000	-8.083945	-3.128569
Icall_sign_42	-.2425487	1.260623	-0.19	0.847	-2.718629	2.233532
Icall_sign_43	-4.890672	1.260311	-3.88	0.000	-7.36614	-2.415205
Icall_sign_44	-.9587187	1.018831	-0.94	0.347	-2.959877	1.042439
Icall_sign_45	.6412108	.9506553	0.67	0.500	-1.226039	2.508461
Icall_sign_46	.6353323	.9498243	0.67	0.504	-1.230286	2.50095
Icall_sign_47	-5.629707	1.261334	-4.46	0.000	-8.107182	-3.152231
Icall_sign_48	-6.489519	1.261259	-5.15	0.000	-8.966848	-4.012189
Icall_sign_49	-3.452768	1.261658	-2.74	0.006	-5.930881	-.974654
Icall_sign_50	-7.025018	1.258674	-5.58	0.000	-9.49727	-4.552766
Icall_sign_51	2.061212	.8906554	2.31	0.021	.3118122	3.810612
Icall_sign_52	.4631968	.9429862	0.49	0.623	-1.38899	2.315384
Icall_sign_53	2.597685	.7908497	3.28	0.001	1.04432	4.151049
Icall_sign_54	-4.264615	1.258648	-3.39	0.001	-6.736814	-1.792415
Icall_sign_55	-1.767871	1.260604	-1.40	0.161	-4.243913	.7081709
Icall_sign_56	.3968064	.9446381	0.42	0.675	-1.458625	2.252238
Icall_sign_57	2.317041	.9447012	2.45	0.014	.4614862	4.172597
Icall_sign_58	1.026207	.9373854	1.09	0.274	-.8149792	2.867392
Icall_sign_59	-3.977889	1.029736	-3.86	0.000	-6.000468	-1.95531
Icall_sign_60	-6.549585	1.260297	-5.20	0.000	-9.025026	-4.074145
Icall_sign_61	5.801139	.7908624	7.34	0.000	4.24775	7.354528
Icall_sign_62	-2.617757	1.2604	-2.08	0.038	-5.0934	-.1421146
Icall_sign_63	3.101528	.9350256	3.32	0.001	1.264977	4.938079
Icall_sign_64	-2.483567	1.261314	-1.97	0.049	-4.961004	-.0061293
Icall_sign_65	-1.064126	1.031591	-1.03	0.303	-3.090348	.9620965
Icall_sign_66	-5.052962	1.260391	-4.01	0.000	-7.528586	-2.577338
Icall_sign_67	-2.414281	1.260204	-1.92	0.056	-4.889537	.060975
Icall_sign_68	-2.343573	1.260969	-1.86	0.064	-4.820333	.1331861
Icall_sign_69	3.075695	.9387242	3.28	0.001	1.23188	4.919511
Icall_sign_70	1.798203	1.402462	1.28	0.200	-.9564724	4.552879
Icall_sign_71	2.998108	.9426862	3.18	0.002	1.146511	4.849706
Icall_sign_72	-2.467716	1.261449	-1.96	0.051	-4.945417	.0099863
Icall_sign_73	1.489806	.8966609	1.66	0.097	-.2713898	3.251002
Icall_sign_74	-3.298026	1.263631	-2.61	0.009	-5.780015	-.816038
Icall_sign_75	-.6341758	1.26154	-0.50	0.615	-3.112056	1.843705
Icall_sign_76	-3.871544	1.259091	-3.07	0.002	-6.344616	-1.398472
Icall_sign_77	-.6714731	1.031067	-0.65	0.515	-2.696666	1.35372
Icall_sign_78	-1.22952	1.03194	-1.19	0.234	-3.256426	.7973871
Icall_sign_79	1.785146	.8115001	2.20	0.028	.191221	3.379072
Icall_sign_80	-1.111893	1.031537	-1.08	0.282	-3.138008	.9142227
Icall_sign_81	-.2606329	1.260251	-0.21	0.836	-2.735982	2.214717
Icall_sign_82	-.0446787	1.258614	-0.04	0.972	-2.516813	2.427456
Icall_sign_83	-4.601076	1.258666	-3.66	0.000	-7.073312	-2.128839
Icall_sign_84	-3.908384	1.258679	-3.11	0.002	-6.380646	-1.436122
Icall_sign_85	-4.484991	1.260484	-3.56	0.000	-6.960797	-2.009184

Icall_sign_86	1.535115	1.044206	1.47	0.142	-.515885	3.586115
Icall_sign_87	-4.509198	1.262006	-3.57	0.000	-6.987994	-2.030402
Icall_sign_88	1.022585	.9393985	1.09	0.277	-.8225552	2.867725
Icall_sign_89	1.114166	1.264073	0.88	0.378	-1.36869	3.597022
Icall_sign_90	-4.774251	1.030495	-4.63	0.000	-6.798321	-2.750182
Icall_sign_91	-.486904	.8650955	-0.56	0.574	-2.1861	1.212292
Icall_sign_92	-2.637263	1.030879	-2.56	0.011	-4.662087	-.6124397
Icall_sign_93	-6.471765	1.26006	-5.14	0.000	-8.946739	-3.996791
Icall_sign_94	.232675	.9371247	0.25	0.804	-1.607999	2.073349
Icall_sign_95	-1.091879	.9419829	-1.16	0.247	-2.942095	.7583369
Icall_sign_96	.6165493	1.035522	0.60	0.552	-1.417393	2.650492
Icall_sign_97	-7.303031	1.261205	-5.79	0.000	-9.780253	-4.825808
Icall_sign_98	-4.533441	1.261597	-3.59	0.000	-7.011435	-2.055448
Icall_sign_99	.3831394	.910241	0.42	0.674	-1.40473	2.171009
Icall_sign_100	2.572267	1.262683	2.04	0.042	.0921413	5.052394
Icall_sign_101	-4.272457	1.258594	-3.39	0.001	-6.744551	-1.800363
Icall_sign_102	-3.129472	1.26144	-2.48	0.013	-5.607155	-.6517877
Icall_sign_103	.5130589	.8373473	0.61	0.540	-1.131635	2.157753
Icall_sign_104	-.943167	1.031327	-0.91	0.361	-2.96887	1.082536
Icall_sign_105	2.329271	.8936802	2.61	0.009	.57393	4.084612
Icall_sign_106	-2.476357	1.25863	-1.97	0.050	-4.948522	-.0041911
Icall_sign_107	-.2661383	.863156	-0.31	0.758	-1.961525	1.429248
Icall_sign_108	3.975126	.9374865	4.24	0.000	2.133742	5.81651
Icall_sign_109	4.875726	.8002546	6.09	0.000	3.303889	6.447564
Icall_sign_110	4.582319	.897794	5.10	0.000	2.818898	6.34574
Icall_sign_111	-6.853311	1.031764	-6.64	0.000	-8.879873	-4.82675
Icall_sign_112	-.1939332	1.260996	-0.15	0.878	-2.670745	2.282879
Icall_sign_113	-4.359564	1.259317	-3.46	0.001	-6.833078	-1.88605
Icall_sign_114	5.464674	.7937122	6.88	0.000	3.905687	7.023661
Icall_sign_115	-2.268989	1.260383	-1.80	0.072	-4.744598	.2066198
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Icall_sign_117	.9789936	1.039353	0.94	0.347	-1.062475	3.020462
Icall_sign_118	-4.197929	1.258636	-3.34	0.001	-6.670107	-1.725752
Icall_sign_119	.4771443	.8869174	0.54	0.591	-1.264914	2.219202
Icall_sign_120	.7029111	1.044667	0.67	0.501	-1.348993	2.754816
Icall_sign_121	1.481596	.8366056	1.77	0.077	-.1616409	3.124833
Icall_sign_122	1.911743	.8157833	2.34	0.019	.309405	3.514082
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Icall_sign_124	-.8385141	.8937299	-0.94	0.349	-2.593953	.9169248
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Icall_sign_126	-.8032635	.9424462	-0.85	0.394	-2.654389	1.047863
Icall_sign_127	-4.735198	1.261323	-3.75	0.000	-7.212653	-2.257743
Icall_sign_128	-4.398805	1.258614	-3.49	0.001	-6.870939	-1.926671
Icall_sign_129	-8.847538	1.260678	-7.02	0.000	-11.32373	-6.371349
Icall_sign_130	4.079662	.8302396	4.91	0.000	2.448929	5.710395
Icall_sign_131	-6.284676	1.261296	-4.98	0.000	-8.762078	-3.807273
Icall_sign_132	-2.553478	1.260293	-2.03	0.043	-5.02891	-.0780467
Icall_sign_133	-3.720723	1.263046	-2.95	0.003	-6.201563	-1.239883
Icall_sign_134	1.687936	.821747	2.05	0.040	.073884	3.301988
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Icall_sign_139	-6.645954	1.258592	-5.28	0.000	-9.118045	-4.173862
Icall_sign_140	5.921318	.7912543	7.48	0.000	4.367159	7.475477
Icall_sign_141	2.267771	.7926782	2.86	0.004	.7108146	3.824727
Icall_sign_142	-8.305287	1.261259	-6.58	0.000	-10.78262	-5.827957
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Icall_sign_146	-6.957845	1.261466	-5.52	0.000	-9.435581	-4.480109
Icall_sign_147	-2.469542	1.260527	-1.96	0.051	-4.945434	.0063494
Icall_sign_148	2.126898	.8333667	2.55	0.011	.4900227	3.763773

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Icall_sign_164	-4.004126	1.258614	-3.18	0.002	-6.476259	-1.531992
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Icall_sign_174	1.001442	.8875521	1.13	0.260	-.7418621	2.744747
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Icall_sign_183	-3.520759	1.029732	-3.42	0.001	-5.543328	-1.498189
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Icall_sign_189	-3.644346	1.029473	-3.54	0.000	-5.666409	-1.622284
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Icall_sign_198	-1.456583	.9428676	-1.54	0.123	-3.308537	.3953709
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Icall_sign_200	-1.086997	1.030895	-1.05	0.292	-3.111852	.9378574
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Icall_sign_209	-5.23699	1.25899	-4.16	0.000	-7.709863	-2.764118
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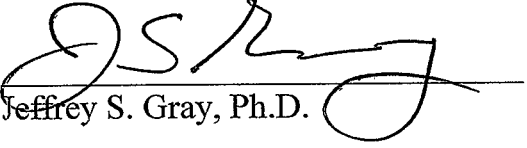
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Icall_sign_223	-4.542534	1.260306	-3.60	0.000	-7.017992	-2.067077
Icall_sign_224	-6.278777	1.26127	-4.98	0.000	-8.756127	-3.801427
Icall_sign_225	-4.577942	1.258606	-3.64	0.000	-7.05006	-2.105824
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Icall_sign_227	-4.358488	1.258702	-3.46	0.001	-6.830793	-1.886182
Icall_sign_228	1.601851	.8883055	1.80	0.072	-.1429331	3.346636
Icall_sign_229	-6.192828	1.261605	-4.91	0.000	-8.670836	-3.71482
Icall_sign_230	6.086597	.7901067	7.70	0.000	4.534692	7.638502
Icall_sign_231	-1.386262	1.260299	-1.10	0.272	-3.861706	1.089182
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Icall_sign_243	-3.810538	1.261999	-3.02	0.003	-6.289321	-1.331755
Icall_sign_244	2.596578	.9543565	2.72	0.007	.7220583	4.471098
Icall_sign_245	-3.398883	1.260497	-2.70	0.007	-5.874715	-.9230515
Icall_sign_246	-.3603376	.9983231	-0.36	0.718	-2.321215	1.60054
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Icall_sign_257	-2.182727	1.258599	-1.73	0.083	-4.65483	.2893765
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Icall_sign_269	-1.829735	1.260354	-1.45	0.147	-4.305286	.6458161
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_Icall_sign_305	-.3407956	.9266492	-0.37	0.713	-2.160894	1.479302
_Icall_sign_306	-2.304629	1.258599	-1.83	0.068	-4.776732	.1674746
_Icall_sign_307	-4.903546	1.260132	-3.89	0.000	-7.378662	-2.428431
_Icall_sign_308	-2.94452	.9414444	-3.13	0.002	-4.793678	-1.095362
_cons	10.89631	.7548044	14.44	0.000	9.413747	12.37888

DECLARATION OF JEFFREY S. GRAY, PH.D.

I declare under penalty of perjury that the foregoing testimony is true and correct,
and of my personal knowledge.

Executed on December 15, 2017


Jeffrey S. Gray, Ph.D.

CERTIFICATE OF SERVICE

I hereby certify that on this 15th day of December, 2017, a copy of the foregoing pleading was provided to each of the parties listed below, either electronically via the Copyright Royalty Judges' eCRB electronic filing system for those parties receiving service through eCRB, or by Federal Express overnight mail.

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